B.Tech
APJ Abdul Kalam Technological University
RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY

Department of Computer Science & Engineering

RSET Vision

To evolve into a premier technological and research institution, moulding eminent professionals with creative minds, innovative ideas and sound practical skill, and to shape a future where technology works for the enrichment of mankind.

RSET Mission

To impart state-of-the-art knowledge to individuals in various technological disciplines and to inculcate in them a high degree of social consciousness and human values, thereby enabling them to face the challenges of life with courage and conviction.

Department Vision

To become a Centre of Excellence in Computer Science & Engineering, moulding professionals catering to the research and professional needs of national and international organizations.

Department Mission

To inspire and nurture students, with up-to-date knowledge in Computer Science & Engineering, ethics, team spirits, leadership abilities, innovation and creativity to come out with solutions meeting the societal needs.

PROGRAM SPECIFIC OUTCOMES (PSOs)

A graduate of the Computer Science and Engineering Program will demonstrate:

PSO1: Computer Science Specific Skills:

- The ability to identify, analyze and design solutions for complex engineering problems in multidisciplinary areas by understanding the core principles and concepts of computer science and thereby engage in national grand challenges.
PSO2: Programming and Software Development Skills

- The ability to acquire programming efficiency by designing algorithms and applying standard practices in software project development to deliver quality software products meeting the demands of the industry.

PSO3: Professional Skills:

- The ability to apply the fundamentals of computer science in competitive research and to develop innovative products to meet the societal needs thereby evolving as an eminent researcher and entrepreneur.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. *(Level 3)*

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. *(Level 6)*

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. *(Level 6)*

4. **Conduct investigations of complex problems:** Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. *(Level 5)*

5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. *(Level 6)*

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice. *(Level 5)*

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. *(Level 3)*
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. **(Level 3)**

9. **Individual and Team work:** Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings. **(Level 3)**

10. **Communication:** Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions. **(Level 6)**

11. **Project management and finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments. **(Level 5)**

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change. **(Level 5)**
In exercise of the Powers conferred under Clause 44 of the Ordinance, the Executive Committee of the University hereby promulgate the Ordinance for the University for the Academic Year 2015-2016. This Ordinance shall come into effect from the date of its publication in the Gazette.

I N D E X

01 Admission to Bachelor of Technology / B.Tech. / B.Tech. (Honours)
02 Examination
03 Eligibility for Award of Degree
04 Fee structure
05 Discipline of the student – Action against breach of discipline
06 Action against breach of guidelines in Examinations - unfair measures in examination
07 Miscellaneous Provisions:
   a) Language of Instruction and Evaluation
   b) Academic Calendar
   c) Branches of B. Tech. Programmes
   d) B. Tech. Programme Structure
   e) Curriculum, List of Courses and Syllabi
   f) Faculty Advisor/Counsellor
   g) Course Registration and Enrolment
   h) Course Completion and Earning of Credits
   i) Core courses, Prerequisites and Electives
j) End Semester and Supplementary Examinations  
k) Summer Courses and Contact Courses  
l) Academic Assessment/Evaluation  
m) Eligibility to Continue  
n) Course Committees and Class Committees  
o) Eligibility for Grading  
p) Award of Grades  
q) Grades and Grade Points  
r) Academic Auditing  
s) Break of Study  
t) Revaluation and Grade Improvement  
u) Grade Cards  
v) B. Tech Degree  
w) B. Tech. (Honours)  
x) Discipline  
y) Academic Discipline and Welfare Committee  
z) Grievances and Appeals Committee  

8. Amendment to Ordinance/Regulations/Rules  
Rules to carry out the purpose of the Ordinance  
Addendum  

1. Admission to Bachelor of Technology / B.Tech. / B.Tech. (Honours)  
   a. Eligibility for admission to the B.Tech., programme, admission policy and procedure shall be decided from time to time by following the guidelines issued by the Government of Kerala and the Government of India and other statutory body such as AICTE.  
   b. Subject to Clause 1(a), Admission to B.Tech., shall be based on the guidelines given by the State and Central Governments on reservation. Candidates for admission to B.Tech., programme shall have passed the Higher Secondary Examination, Kerala or 12th Standard V.H.S.E., C.B.S.E., I.S.C or any other examination considered equivalent to the above mentioned ones. Other eligibility criteria for admission is currently prescribed by the Government of Kerala through Government orders which is based on the entrance examination conducted by the Commission for Entrance Examinations, Government of Kerala and the marks in the qualifying examination subject to the relaxations allowed for backward classes and other communities as specified from time to time.  
   c. The Branches of study and number of students admitted are to be based on the approval by the All India Council for Technical Education and the Kerala Technological University.  
   d. Notwithstanding all that is stated above, the admission policy may be modified from time to time by the University, particularly to confirm to directions from the Government of Kerala and the Government of India.
e. The B.Tech., / B.Tech. (Honours) programme is a credit based programme. The duration of the B. Tech / B. Tech (Honours) programme will normally be four academic years spanning 8 semesters. The maximum duration shall be six academic years spanning 12 semesters.

2. Examination

a. At the end of the semester, end semester examination will be conducted in all lecture based courses offered in the semester and will normally be of three hours duration, unless otherwise specified. Supplementary examinations shall be conducted before the commencement of the next semester, for students who are eligible and have registered for them.

b. Students, who have completed a course but could not write the end semester examination for valid reasons like illness or personal exigencies, are allowed to write the supplementary examination or the end semester examination at the next opportunity and earn the credits without having to register for the course again provided they meet other eligibility criteria.

c. The main eligibility criteria for the end semester examination are attendance in the course, internal marks and no pending disciplinary action. The minimum attendance for appearing for the end semester examination is 75% in each course. Further, the internal evaluation marks in the course should be 45% or above. Students who do not meet these eligibility criteria are awarded an FE grade and have to register for the course again.

d. Students who could not write the end semester examination due to health reasons or other exigencies can register for the supplementary examination, with the approval of the principal provided they have 45% or above marks in the internal evaluations for the course. Candidates who received F grade can also write the supplementary examination. Grades awarded in the supplementary examination will be taken as the end semester grades in these courses.

3. Eligibility for Award of Degree

The award of B. Tech. / B. Tech. (Honours) degree shall be based on the recommendation of the Academic Committee and the approval of the Board of Governors and in accordance with the academic regulations, if any, issued for the said purpose by the University.

Award of B. Tech. Degree

A student will be eligible for the award of B. Tech. Degree of the University on satisfying the following requirements.

i) Earned credits for all the core courses and the Project.

ii) Earned the required minimum credits as specified in the curriculum for the branch of study.
iii) No pending disciplinary action.

4. **Fee charged by the University**

Fee charged for the programme shall be decided by the University from time to time and informed to all concerned for compliance.

5. **Discipline of the student – Action against breach of discipline**

Every college shall have a Student’s Welfare Committee and a Disciplinary Action Committee, constituted by the Principal of the college. Each college should have a Grievance Redressal and Appeals Committee constituted by the Principal to address the grievances of the students and to consider their appeals on any decisions made by the college. Details on the constitution and terms of reference are outlined in 7-x, 7-y, and 7-z.

6. **Breach of guidelines and unfair practices in Examinations**

These are viewed seriously and appropriate actions are to be taken by the colleges as detailed in 7-x.

   a. **Language of Instruction and Examination.**

   Unless otherwise stated, the language of instruction and examinations shall be English.

   b. **Academic Calendar.**

   The University shall publish in its website the academic calendar for every academic semester indicating the commencement of the semester and beginning of instruction. It will specify the course registration and enrolment dates, the schedule for mandatory internal tests for theory courses, dates by which laboratory/practical evaluations are to be completed, date for finalization of internal marks, last instruction day in the semester, planned schedule of end semester examinations and result declaration as well as approved holidays falling within the semester. Schedules for the supplementary examinations and result declaration dates are to be included in the calendar. Summer course schedule and result declaration have also to be indicated in the calendar. Additionally colleges may publish their academic calendar, in line with the University academic calendar, indicating other schedules and events they plan to conduct during the semester.

   c. **Branches of B. Tech. Programmes.**

   The Branches of B. Tech. /B. Tech. (Honours) programme offered by the University are listed separately at the end of this Ordinance.

   d. **B. Tech. Programme Structure**

   i) B. Tech. / B. Tech. (Honours) programme in all branches of study is structured on a credit based system following the semester pattern with continuous evaluation allowing flexibility for students to decide on the duration of programme completion.
ii) The duration for the B. Tech. /B. Tech. (Honours) programme in all branches of study, will normally be 8 semesters.

iii) The maximum duration shall be six academic years spanning 12 semesters.

iv) Each semester shall have 72 instructional days, followed by end semester examinations.

v) A student can opt for B.Tech. (Honours) at the end of the fourth semester.

vi) The curriculum of any branch of the B. Tech. programme is designed to have a minimum of 180 academic credits and 2 additional pass/fail credits, for the award of the degree.

vii) The University follows Credit System and Credits are apportioned among the following knowledge segments.

<table>
<thead>
<tr>
<th>Knowledge Segments</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Sciences [8 Theory + 2 Labs]</td>
<td>10</td>
</tr>
<tr>
<td>Mathematics</td>
<td>16</td>
</tr>
<tr>
<td>Humanities</td>
<td>9</td>
</tr>
<tr>
<td>Basic Engineering [25 Theory + 4 Labs]</td>
<td>29</td>
</tr>
<tr>
<td>Professional Engineering [80 Theory + 9 Labs]</td>
<td>89</td>
</tr>
<tr>
<td>Electives</td>
<td>15</td>
</tr>
<tr>
<td>Seminar</td>
<td>2</td>
</tr>
<tr>
<td>Comprehensive Viva</td>
<td>2</td>
</tr>
<tr>
<td>Design Project</td>
<td>2</td>
</tr>
<tr>
<td>Project</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total Academic Credits:</strong></td>
<td><strong>180</strong></td>
</tr>
<tr>
<td>Student’s Activities [Audit-Pass/Fail]</td>
<td>2</td>
</tr>
<tr>
<td>Total credits for B.Tech. Degree</td>
<td>182</td>
</tr>
</tbody>
</table>

Credits are assigned to courses based on the following general pattern.

- One credit for each lecture hour per week for one semester
- One credit for each tutorial hour per week for one semester
- One credit for each laboratory/practical session of 2 or 3 hrs, per week for one semester

viii) In a semester normally up to six lecture based courses and three laboratory/practical courses, carrying a maximum credit of 26, could be offered.
ix) University may allow students to transfer credits they have earned at other Universities and Academic Institutions, as per the guidelines given by the Academic Committee and approved by the Board of Governors.

x) Student Activities Points:

To be an engineer capable of competing globally, in addition to technical knowledge and skills, students should develop excellent soft skills, nurture team work and leadership qualities and have an entrepreneurial and trail blazing outlook. To achieve this, in addition to academics, students are to actively engage in co-curricular and extra-curricular activities. For such activities, points are allotted. On getting a minimum of 100 activity points the student passes the course and earns 2 credits which do not count for the CGPA but mandatory for the award of the degree. Listing of these activities and the maximum points that could be earned by engaging in them are given at the end of this document. Additional activities could be included in the list with the approval of the Academic Committee.

e. Curriculum, List of Courses and Syllabi

i) Every branch of study in the B.Tech., programme will have a curriculum, list of courses, syllabi and course plans approved by the Academic Committee of the University.

ii) Courses are categorized as Core Theory (CT), Core Practice (CP) and Electives (EL).

iii) Each course has a course number. Course number includes the offering department or knowledge segment code and a three digit number. Knowledge segment code is used when a course is offered by any one or more departments with the same course content and syllabus. Details on this are given under Rule, RU-1.

f. Faculty Advisor/Counsellor

All students shall have faculty advisors whose role will be:-
To guide and help students on academics
To monitor their progress in academics and advise them
To counsel them and hand-hold them in any difficulty

g. Course Registration and Enrolment

It is mandatory for students to register for the courses they want to attend in a semester. Students admitted freshly to the first semester, are advised to register for all courses listed for the semester. However they do not have to enrol for the
semester. All other students are required to register at the end of the semester for the courses they desire to take in the coming semester. They have to enrol for these courses at the beginning of the new semester, based on the previous semester results. This allows them to make changes in the list of courses already registered for. Before enrolment, students should clear all dues including any fees to be paid and should not have any disciplinary issues pending. The dates for registration and enrolment will be given in the academic calendar. Any late registration or enrolment, allowed up to 7 working days from the stipulated date, will attract a late fee.

A student can withdraw from a course or substitute one already registered by another on valid reasons with the approval of the faculty advisor. However, this has to be done within seven working days from the commencement of the semester. The maximum number of credits a student can register in a semester is limited to 26.

h. **Course Completion and Earning of Credits**

Students registered and later enrolled for a course have to attend the course regularly and meet the attendance rules of the university [RU-2] and appear for all the internal evaluation procedures for the completion of the course. Credits for the course are earned only on getting a pass grade in the composite evaluation.

i) **Core courses, Prerequisites and Electives**

All courses listed in the curriculum, other than the electives, are core courses. Earning credits in the core courses is mandatory for the B. Tech. degree. For electives, failure to earn credits does not necessarily require repeating the course. Instead, another approved elective is permitted as a replacement course by the faculty advisor concerned. For some courses there could be a prerequisite course completion requirement for registration.

J) **Summer Courses**

Students who could not earn the required minimum credits at the end of the second or fourth semester have two options to continue with the studies. They may register again for the courses, when they are offered in the next academic year. However, there is also a provision to run summer courses in failed courses for these students who may register and attend the course and write the final examination. This provision is only for students who have got 45% or more in the internal evaluation for the courses they attended in the regular semester.

Students should have 75% attendance in the summer course to write the examination.
For the final grading their internal evaluation marks obtained in the regular semester in which they had undergone the course shall be applicable. Summer courses are to be conducted for a minimum of 20 contact hours for each course. Summer courses are to be offered only at the end of the second and fourth semesters for the courses covered till that semester. They will be conducted either by all colleges or only by some, depending on the number of students registering for them. Details of summer courses planned will be announced by the colleges after the declaration of the even semester results. Final examination for summer courses will be conducted by the University. Based on the availability of faculty and the number of students opting for courses, it will be the prerogative of the colleges to decide on the summer courses to be offered.

Options for the fifth and higher semesters

For higher semesters, i.e., fifth semester onwards, summer courses are not offered. Failed students who have less than 45% marks in internal assessments have to register again for the course in the regular semester in which it is offered and complete the course as per the regulations and appear for the end semester examination. Failed students having 45% marks or more in internal assessments have the option to register again for the course as mentioned above or register only for the end semester examination without attending the course again. A separate registration format will be available for this. This option is available in all semesters.

k) Contact Courses

If a student has to earn credits only just for one course to qualify for the degree after completing eight semesters of study, the college concerned may offer a contact course on a written request by the student. The contact course is considered as fresh registration and is to be offered by the teacher concerned who shall conduct the internal evaluation procedures and allot the marks as per the regulations. Minimum contact hours for the course shall be 20. The final examination will be conducted by the college and shall be monitored by the external academic auditor. Question paper for the examination will be given by the Controller of Examination. No grade above C shall be given for a contact course.

l) Academic Assessment/Evaluation

Academic Evaluation of Courses
University follows a continuous academic evaluation procedure.
Academic evaluation procedure and corresponding weights are as follows:-

a) For theory courses: - 1/3rd weightage for internal evaluation and 2/3rd for end semester examination.
For convenience, the maximum marks for internal evaluation and end semester examination for theory courses are fixed as 50 and 100 respectively.

Scheme of evaluation is as follows.

i) Two internal tests each of 20 marks and of one hour duration. (Internally by the College)

ii) Tutorials/Assignments/Mini Projects carrying 10 marks. (Internally by the College)

iii) End Semester examination carrying 100 marks. (Conducted by the University)

All the above evaluations are mandatory requirements to earn credits. Students who have missed either the first or the second test can register with the consent of the faculty and the Head of the Department (HOD) concerned for a re-test which shall be conducted soon after the completion of the second test, but before the end semester examination. The re-test will cover both first and second test course plans. Those who have missed both the tests are not eligible to appear for the end semester examination.

However if one misses both tests due to medical reasons or other personal exigencies, based on genuine evidence, a single test of 2 hour duration for 40 marks will be conducted covering the whole syllabus, before the end semester examinations. Decision on this will be taken by the Principal and verified by the external academic auditor.

b) For Laboratory /Practical /Workshop courses

i) Practical records /Outputs 60 marks (Internally by the College)

ii) Regular class Viva 10 marks (Internally by the College)

iii) Final written test/quiz 30 marks (Internally by the College)

All the above assessments are mandatory to earn credits. If not, the student has to complete the course/assessments during his free time in consultation with the faculty members. On completion of these, grades will be assigned. In case the Practical /Laboratory/Workshop courses are not completed in the semester, grade I (incomplete) will be awarded against the course and the final grade will be given only after the completion of the course/assessments.

c) Comprehensive Examination

As students appear for placements from seventh semester onwards, comprehensive examination is to be completed in the sixth semester. This examination will be a written cum oral examination covering broadly all courses so far completed [RU-5].
d) Seminar
Each student has to give a seminar on a professional topic of current interest in consultation with the faculty member in charge of the seminar in the Department. The seminar will be evaluated based on RU-6.

e) Design Project
Each student or a group of students has to take up a design project. The project topic could be arrived at in consultation with any faculty member in the department. The evaluation of the project is to be done in two stages. Two project progress evaluations each carrying 20 marks and a final report evaluation and presentation of the project for 60 marks. The project supervisor and two other faculty members from the same or any other department, nominated by the Head of the Department form the evaluation board.

f) Final Semester Project
Students, either individually or in a small batch not exceeding four, have to do a project approved by their faculty supervisor.
Evaluation scheme is given below:

i) Two progress assessments 20% by the faculty supervisor/s
ii) Final Project Report 30% by the Assessment Board
iii) Project presentation and Viva 50% by the Assessment Board

If the project work is not completed satisfactorily, the student has to put in more work and appear again for assessment on a specified date, not earlier than one month after the first evaluation. If the student fails in the project, a fresh registration for the project for one semester is mandatory.

The project assessment board shall consist of the following members.
Chairman: Head of the Department
Members: Project supervisor/s of the student
One faculty member from the Department
One faculty member from a sister Department
An external expert, either from an academic/research institute or industry

m) Eligibility to Continue
A student has to earn a minimum number of credits in a semester to be eligible to register for the new courses offered in the next semester. In odd semesters if this requirement is not met, the student is to be forewarned and allowed to continue to the next even semester. However at the end of even semesters this requirement will be strictly implemented. Summer courses are offered to those who do not satisfy this norm after the 2nd as well as the 4th semesters. Students who do not meet this requirement are not permitted to register for new courses in the higher semesters. They have to register for the failed courses in normal semesters in which
they are offered subject to the limitations imposed by the ordinances and course timetable.

Action plan, for dealing with course arrears in theory courses at the end of each semester to continue with the programme, is given below. Faculty advisors shall monitor advice and support the students in this. Students should be informed about the minimum cumulative credits requirement to register for higher semester courses.

Eligibility Criteria for Registering for Higher Semester Courses

<table>
<thead>
<tr>
<th>Semester</th>
<th>Allotted Credits</th>
<th>Cumulative Credits</th>
<th>Minimum cumulative credits required to register for courses in higher semesters</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>24</td>
<td>24</td>
<td>Not insisted</td>
</tr>
<tr>
<td>Second</td>
<td>23</td>
<td>47</td>
<td>35</td>
</tr>
<tr>
<td>Third</td>
<td>24</td>
<td>71</td>
<td>Not insisted</td>
</tr>
<tr>
<td>Fourth</td>
<td>23</td>
<td>94</td>
<td>80</td>
</tr>
<tr>
<td>Fifth</td>
<td>23</td>
<td>117</td>
<td>Not insisted</td>
</tr>
<tr>
<td>Sixth</td>
<td>23</td>
<td>140</td>
<td>126</td>
</tr>
<tr>
<td>Seventh</td>
<td>22</td>
<td>162</td>
<td>Not insisted</td>
</tr>
<tr>
<td>Eighth</td>
<td>18</td>
<td>180</td>
<td></td>
</tr>
</tbody>
</table>

n) **Course Committees and Class Committees**

These committees are to be in place in each college affiliated to the University.

a) **Course Committee**

This is for common courses (electives are excluded) offered to students admitted for the B. Tech. programme irrespective of their branch of study. Each of such courses will have a course committee constituted by the Principal of the college.

The chairman of the course committee shall be a senior faculty member not offering the course.

Members:-

i) All teachers offering the course.

ii) Four student representatives nominated by the Principal.

b) **Class Committee**

Beginning from the third semester, all branches of study will have class committees for every semester constituted by the respective Heads of Departments.
The chairman of the committee shall be a senior faculty member who does not offer any course during that semester.

Members:-

i) All faculty members teaching courses in that semester.
ii) Two student representatives nominated by the head of the Department.

The course committees and class committees shall meet at least thrice in a semester – the first at the beginning of the semester, the second and the third after the first and the second internal tests respectively. Both committees should monitor the conduct of the courses, adherence to the course plan and time schedule, completion of the syllabus, standards of internal tests, evaluation process and difficulties faced by the students and take suitable remedial actions at the appropriate time. At the end of the semester, the committee should meet without student representatives to review the conduct of the course and finalize the internal assessment marks and approve them.

o) **Eligibility for writing the end semester examination and for grading**

Students with 45% or more marks in internal assessment in a course shall only be permitted to write the end semester examination in that course. Those with less than 45% internal marks shall be awarded FE grade and have to register for the course again.

A student should have a minimum of 45% marks in the end semester examination to be eligible for grading in a course. Otherwise he/she will be considered to have failed in the course and an F grade will be awarded.

Internal marks given to the students who got 45% marks or more in the end semester examination shall be regulated in line with the end semester examination performance. Internal mark percentage shall not exceed 25% over the end semester mark %.

(For example if the end semester mark % is 45, then the maximum internal mark % is to be 45+25 = 70 %.)

In case the student writes the supplementary examination, the mark got in that will be taken into consideration for regulating the internal marks.

Those who have more than 45% marks in the end semester examination are awarded the grade based on both internal assessment and end semester examination marks. A student earns credits for a course if the grade is P or above.

p) **Award of Grades**

Grading is based on the % marks obtained by the student in a course, as given in 7q. The grade card will only give the grades against the courses the student has registered.
Semester grade card will give the grade for each registered course, Semester Grade Point Average (SGPA) for the semester as well as Cumulative Grade Point Average (CGPA).

q) Grades and Grade Points

Grades and Grade Points as per UGC guidelines is to be followed by the University.

<table>
<thead>
<tr>
<th>Grades</th>
<th>Grade Point (GP)</th>
<th>% of Total Marks obtained in the course</th>
</tr>
</thead>
<tbody>
<tr>
<td>O (Outstanding)</td>
<td>10</td>
<td>90% and above</td>
</tr>
<tr>
<td>A⁺ (Excellent)</td>
<td>9</td>
<td>85% and above but less than 90%</td>
</tr>
<tr>
<td>A (Very Good)</td>
<td>8</td>
<td>80% and above but less than 85%</td>
</tr>
<tr>
<td>B⁺ (Good)</td>
<td>7</td>
<td>70% and above but less than 80%</td>
</tr>
<tr>
<td>B (Above Average)</td>
<td>6</td>
<td>60% and above but less than 70%</td>
</tr>
<tr>
<td>C (Average)</td>
<td>5</td>
<td>50% and above but less than 60%</td>
</tr>
<tr>
<td>P (Pass)</td>
<td>4</td>
<td>45% and above but less than 50%</td>
</tr>
<tr>
<td>F (Fail)</td>
<td>0</td>
<td>Less than 45%</td>
</tr>
<tr>
<td>FE</td>
<td>0</td>
<td>Failed due to eligibility criteria [7-o]</td>
</tr>
</tbody>
</table>

I Course Incomplete

SGPA and CGPA are calculated based on the above grading norms and are explained at the end of this document.

r) Academic Auditing

The University shall have a detailed academic auditing procedure in place comprising of an internal academic auditing cell within the colleges and an external academic auditing for each college. The internal academic auditing cell in each college shall oversee and monitor all the academic activities including all internal evaluations and examinations. This cell is to prepare academic audit statements for each semester at regular intervals. These reports are to be presented to the external academic auditor approved by the University, who will use it as a reference for his independent auditing and for the final report to the University.

Academic auditing shall cover:-

i) Course delivery covering syllabus, adherence to course plan, quality of question papers for internal examinations, internal evaluation, laboratory experiments, practical assignments, mini projects and conduct of practical classes and their evaluation.

ii) Co-curricular and Extra-curricular activities available for students, their organization and the mechanism of monitoring of activities points earned by the students.

iii) Academic functioning of the college encompassing students, faculty and college administration covering punctuality, attendance, discipline, academic
environment, academic accountability, academic achievements and benchmarking.

s) Break of Study

A student may break study for a maximum duration of two semesters, preferably in one academic year, to initiate start-up ventures, product development etc. This is however permitted only on successfully completing the courses listed out in the first four semesters. Request for this with ample evidence to the seriousness of the venture should be forwarded to the college principal for approval. [RU-3]

Break of study on serious health reasons is also permitted with the approval of the college Principal. [RU-3]

All such cases of break of study are to be reported to the University. In both the cases, the maximum duration for completing the B. Tech. programme will still be twelve semesters.

t) Revaluation and Grade Improvement

There is no provision for revaluation of the end semester answer books or for improving the grade.

However, the student is permitted to check the answer books of the end semester examination after the results are declared. Any discrepancy in evaluation could be brought to the notice of the teacher concerned who will initiate appropriate action on this. The decision of the Controller of Examination shall be final on this.

u) Grade Cards

Students who have written the end semester examination will be given the grade cards for the registered courses, in every semester by the respective colleges. On earning the required credits for the degree, a consolidated grade sheet for the B. Tech programme will be given by the University.

v) B. Tech Degree

B.Tech. degree will not have any classifications like distinction or first class.

w) B. Tech. (Honours)

Accredited departments in institutions, having at least two post graduate programmes, may offer B. Tech. (Honours). It should be noted that students with a CGPA above 8 at the end of the fourth semester and having no credit arrears only are eligible for this option. As only selected institutions may have this provision, students cannot demand this or move later to an institute where this is available. Students have to earn 12 additional credits to get B. Tech (Honours). Furthermore their CGPA at the
end of the programme should be 8 or higher. Those who opted for B. Tech (Honours) but unable to earn the required additional credits in 8 semesters or whose final CGPA is less than 8 shall automatically fall back to the B. Tech. programme. However, additional course credits and the grades thus far earned by them will be shown in the grade card but not included for the CGPA.

x) **Academic Discipline and Malpractices in Examinations**

Every student is required to observe discipline and decorous behaviour. Any act of indiscipline, misbehaviour and unfair practice in examinations will be referred to the **Disciplinary Action Committee (DAC)**. Malpractices in examinations shall be viewed seriously and any such incident observed or reported by a faculty member or an invigilator associated with the examinations shall be reported to the Principal who in turn shall refer it to DAC. On the basis of the report and evidence available or gathered, DAC shall immediately initiate an enquiry giving the concerned student a chance to explain his/her case. Based on this the committee shall recommend the course of action in line with the guidelines formulated for this by the Controller of Examination of the University and forward it to the Principal for action.

Actions are to be based on the severity of the offence and are to be dealt with, on a course basis. Guidelines on this shall be given by the Controller of Examination which is to be followed by the Disciplinary Action Committee of the college.

The student may appeal to the Grievances and Appeals Committee for a relook on the matter. Based on the committee’s report, the Principal shall take a final decision on the matter.

DAC shall be headed by a department head and shall have three other faculty members drawn from different departments as members. In case of malpractices in end semester examinations, the report given by the college DAC and the action taken by the Principal shall be intimated to the Controller of Examination of the University.

y) **Student’s Welfare Committee**

Every college shall have a Student’s Welfare Committee, constituted by the Principal of the college. This committee shall have at least three faculty members as members and the chairman shall be a senior faculty member in the rank of a Professor. This committee is entrusted with the task of looking after the welfare of the students by taking appropriate steps with the concurrence of the principal.

z) **Grievances and Appeals Committee**

Each college should have a Grievances Redress Committee constituted by the Principal to address the grievances of the students and to consider their appeals on any decisions made by the college. This committee consisting of at least three faculty
members and chaired by a senior professor shall look into student’s grievances and appeals and give its recommendations to the Principal for action.

8) **Amendment to Ordinance/ Regulations/Rules**

Notwithstanding all that has been stated above, the University has the right to modify any of the above Ordinance/Rules/regulations from time to time.

**RULES:**

**RU-1  Course Code and Course Number**

Each course is identified by a course code and a three digit number. The two letter code refers to the department offering the course or the knowledge segment of the course. The knowledge segment code is used when the course is to be offered by different departments either individually or together but having the same syllabus and course plan.

Course Number: MA 101 - This refers to a course in Mathematics with the course number 101.

Course Number: BE 102 - This refers to a course in Basic Engineering.

Course Number is a three digit number and the first digit refers to the Academic year in which the course is normally offered, i.e. 1, 2, 3, or 4 for the B. Tech. Programme of four year duration. Of the other two digits, the last digit identifies whether the course is offered normally in the odd (odd number), even (even number) or in both the semesters (zero). The middle number could be any digit.

MA 101 is a course in Mathematics offered in the first semester.
EE 344 is a course in Electrical Engineering offered in the sixth semester.
PH 110 is a course in Physics offered both the first and second semesters.
BE 102 is a course in Basic Engineering offered by one or many departments.

These course numbers are to be given in the curriculum and syllabi.

**RU-2  Attendance**

Attendance is marked for each course. While 75% attendance is mandatory for writing the end semester examination in that course, students are expected to have 100% attendance. However under unavoidable circumstances students are permitted to take leave. Leave is normally sanctioned for any approved activity taken up by students outside the college covering sports and other extracurricular activities. Leave is also permitted on medical grounds or on personal exigencies. Leave of absence for all these is limited to 25% of the academic contact hours for the course.
In case of long illness or major personal tragedies/contingencies the college Principal can relax the minimum attendance requirement to 60%, to write the end semester examination. This is permitted for one or more courses registered in the semester. Principal shall keep all records which led to his decision on attendance, for verification by the Academic Auditor. However this concession is applicable only to any two semesters during the entire programme. In case of prolonged illness, break of study is permitted as per RU-3.

RU-3 Break of Study

A student is permitted to have a break of study.

i) In case of accident or serious illness needing prolonged hospitalization and rest.

ii) In case the student has a bright idea and would like to initiate a start-up venture or develop a new product.

iii) In case of any personal reasons that need a break in study.

For break of study due to illness, student should submit all necessary medical reports together with the recommendation of the doctor treating him giving definite reasons for break of study and its duration. Before joining back the student should submit the fitness certificate from the doctor who treated him.

Students who want to initiate a start-up venture or a product development, have to submit a project report, clearly indicating the purpose, action plan, technical details, funding details and future plans to the college Principal. The Principal shall evaluate the proposal by constituting an expert team consisting of a technocrat and a bank executive and take an appropriate decision based on the team’s recommendation. In the semester system followed by the University, break of study for an academic year is preferred over a semester break.

Students who want a break in study due to personal reasons shall convince the Principal on the genuine need for it by giving authentic evidence for the same.

RU-4 Leave of Absence

Students who want to take leave under RU2 have to submit a leave letter to the teacher conducting the course. This letter is to be forwarded to the Head of the Department with recommendation of the teacher indicating the total leave of absence the student has so far availed. Leave is to be sanctioned by the Head of the Department. For medical leave over three days, medical certificate indicating the need for leave is required. After any medical leave exceeding five
instruction days, on rejoining, the student has to produce the fitness certificate given by the doctor.

RU-5 Comprehensive Examination

This examination consists of two parts. Part one a written test and the other an oral one.

The written examination shall be objective type of 1 hour duration and shall have 50 marks and is to be conducted by the concerned department. Chairman of the oral examination board shall be a senior faculty in the department and the members include two other faculty members of the department and an external expert from another academic institute or an industry. Oral examination shall carry 50 marks. Comprehensive examination may be conducted any time during the 6th semester with sufficient notice given to the students.

RU-6 Seminar

Students have to prepare a detailed report on the topic of the seminar and submit it to the teacher concerned. The seminar is to be of 20 minutes duration with another 5 minutes given for questions and answers. All students in the class have to attend the seminar without fail. Evaluation will be based on the report, seminar presentation as well as on the ability of the student to answer the questions put forward. Faculty member in charge of the seminar and another faculty member in the department nominated by the Head of the Department are the evaluators for the seminar. Distribution of marks for the seminar is as follows.

- Marks for the report: 30%
- Presentation: 40%
- Ability to answer questions on the topic: 30%

RU-7 Ragging

Ragging of any nature is a criminal and non-bailable offence. Involvement in ragging shall lead to stringent punishment, including imprisonment as per the law of the land. A student, whose involvement in ragging is established, shall be summarily dismissed from the college. Each student of the Institute, along with his/her parent, is required to give an undertaking in this regard and the same is to be submitted at the time of registration.
Addendum:-

1. Calculation of SGPA/CGPA

Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) are calculated as follows.

SGPA = \( \frac{\sum(C_i \times GP_i)}{\sum C_i} \) where \( C_i \) is the credit assigned for a course and \( GP_i \) is the grade point for that course. Summation is done for all courses registered by the student in the semester. Here the failed courses are also accounted.

CGPA = \( \frac{\sum(C_i \times GP_i)}{\sum C_i} \) where \( C_i \) is the credit assigned for a course and \( GP_i \) is the grade point for that course. Summation is done for all courses registered by the student during all the semesters for which the CGPA is needed. Here the failed courses are also accounted. CGPA of all courses passed may also be given.

CGPA for the B. Tech programme is arrived at by considering all course credits that are needed for the degree and their respective grade points.

2. Student Activity Points

Activities that a student can engage in and the maximum quantum of points that can be earned from them are listed below.

i) National Level Activities

<table>
<thead>
<tr>
<th>Code</th>
<th>Name of activity</th>
<th>Max. Activity Points</th>
<th>Minimum Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA1</td>
<td>N S O</td>
<td>70</td>
<td>Two Semesters</td>
</tr>
<tr>
<td>NA2</td>
<td>N C C</td>
<td>70</td>
<td>Two Semesters</td>
</tr>
<tr>
<td>NA3</td>
<td>N S S</td>
<td>70</td>
<td>Two Semesters</td>
</tr>
</tbody>
</table>

ii) College Level Activities

<table>
<thead>
<tr>
<th>Code</th>
<th>Name of activity</th>
<th>Max. Activity Points</th>
<th>Minimum Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA1</td>
<td>Active Member/Office bearer of Professional Societies (Student Chapters)</td>
<td>30/40</td>
<td>Four Semesters</td>
</tr>
<tr>
<td>CA2</td>
<td>Elected Office bearer of Student forums</td>
<td>30</td>
<td>Two semesters</td>
</tr>
<tr>
<td>CA3</td>
<td>Member/Captain- College Athletic/ Games teams</td>
<td>20/30</td>
<td>Two Semesters</td>
</tr>
<tr>
<td>CA3</td>
<td>Executive Member of Student Clubs</td>
<td>20</td>
<td>Two Semesters</td>
</tr>
<tr>
<td>CA4</td>
<td>Volunteer for important College functions</td>
<td>20</td>
<td>Two Semesters</td>
</tr>
<tr>
<td>CA5</td>
<td>Committee member/ Organizer of Tech Fest/Cultural Fest/ Conference</td>
<td>20/30</td>
<td>Two Semesters</td>
</tr>
</tbody>
</table>
CA6 Placed within top three in Paper presentation/debate/cultural competitions etc 30
CA7 Placed within top three in State level Sports/Games/ 30

Additional 20 points are given for CA3/CA7 if the achievement is at the national level.

iii) Entrepreneurship

EA1 Any Creative Project execution 40
EA2 Awards for Projects 60
EA3 Initiation of Start-ups 60
EA4 Attracted Venture Capital 80
EA5 Filed a Patent 80
EA6 Completed Prototype Development 80

iv) Self Initiatives

SA1 Attend a National Conference 20
SA2 Attend an Int. National Conference 30
SA3 Published/ got an Award for a Technical paper. 30/40
SA4 Organiser of student level Technical Conf/Competition 30
SA5 Foreign language skills 50
SA6 Online courses taken& completed 50

Thiruvanthapuram
26-6-2015 Registrar
Object of the Amendments:

The ordinance for B.Tech/B.Tech (Hons.) and M.Tech degree programs were framed considering the examinations and valuation system would be fully web based and assuming that the results could be published before the commencement of next semester classes. But as the examination system has been changed to the conventional system, it is impossible to publish the results before the commencement of next semester classes. Hence certain amendments are necessary. Also, the Controller of Examinations has suggested certain amendments in the ordinances regarding conduct of examination and malpractices. Further in the Academic Committee meeting also some amendments is suggested and the same is also incorporated.

In exercise of the Powers conferred under Section 44 and Section 45 of Act 17 of 2015, the following clauses are incorporated amending certain provisions of the Ordinance for B.Tech/ B.Tech(Hon) dated 26-6-2015; namely

AMENDMENT ORDINANCE No. 1

1. Short Title and commencement: This Ordinance is called Amendment to Ordinance for B.Tech/B.Tech(Hon) dated 26-6-2015 as Amendment Ordinance No.1 of 2016. This shall come into force with retrospective effect from 26-6-2015.
(i) In **Clause NO. 1(f)**, the following is also to be added. 

For lateral entry to B.Tech/B.Tech (Hons.) programme only diploma holders shall be admitted subject to other eligible conditions prescribed by the Govt. of Kerala from time to time.

(ii) **Clause 2.(a)** under the heading *Examination* shall be amended as follows: -

**Clause 2(a).** At the end of the semester, end semester examination will be conducted in all lecture based courses offered in the semester and will normally be of three hours duration, unless otherwise specified. Supplementary examinations shall be conducted after declaration of results, for students who are eligible and have registered for them.

(iii) **Clause 7 (g)** under the heading *Course Registration and Enrolment* shall be amended as follows:

**Clause 7 (g)**: It is mandatory for students to register for the courses they want to attend in a semester. Students admitted freshly to the first semester, are advised to register for all courses listed for the semester. However they do not have to enroll for the semester. All other students are required to register and enroll for the courses they desire to take in the semester.

(iv) **Clause 7(h)** under the heading “**Course completion and Earning of Credits**”, the following condition to be added

For students admitted under lateral entry scheme the credits for the first and second semesters shall be given by credit transfer from the Diploma programme

(v) **Clause 7(j)** under the heading “**Summer Course**”, the following condition to be added.

The summer courses shall be considered as independent course and students have to register for this course. This provision of summer courses may be extended to students who have got FE grade due to (i) shortage of attendance (ie. having attendance less than 75%) and (ii) shortage of internal evaluation marks (ie. having IA marks less than 45%) with the following conditions.
(i) The students shall have minimum 50% attendance in the specified course of the regular semester. They have to register for the summer course and obtain 75% attendance.

(ii) The students shall have a minimum 35% IA marks in the regular semester. During the summer course the student will get a chance to improve the IA marks by writing one IA make up test during the summer course. This will replace the lower of the two marks got in the regular semester. However the IA marks shall be limited to 50%.

(vi) Clause 7 (l)(b)(iii)

30 marks for final written test /quiz in the evaluation of laboratory /practical courses in 3 to 8 semesters shall be awarded by conducting one end semester internal practical examination.

(iv) Clause 7 (q) Grades and Grade Points is to be amended as follows instead of the UGC Grade Points:

**Clause 7 (q) : Grade and Grade Points**

Grades and Grade Points followed by the University is as follows.

<table>
<thead>
<tr>
<th>Grades</th>
<th>Grade Point (GP)</th>
<th>% of Total Marks obtained in the course</th>
</tr>
</thead>
<tbody>
<tr>
<td>O (Outstanding)</td>
<td>10</td>
<td>90% and above</td>
</tr>
<tr>
<td>A+ (Excellent)</td>
<td>9</td>
<td>85% and above but less than 90%</td>
</tr>
<tr>
<td>A (Very Good)</td>
<td>8.5</td>
<td>80% and above but less than 85%</td>
</tr>
<tr>
<td>B+ (Good)</td>
<td>8</td>
<td>70% and above but less than 80%</td>
</tr>
<tr>
<td>B (Above Average)</td>
<td>7</td>
<td>60% and above but less than 70%</td>
</tr>
<tr>
<td>C (Average)</td>
<td>6</td>
<td>50% and above but less than 60%</td>
</tr>
<tr>
<td>P (Pass)</td>
<td>5</td>
<td>45% and above but less than 50%</td>
</tr>
<tr>
<td>F (Fail)</td>
<td>0</td>
<td>Less than 45%</td>
</tr>
</tbody>
</table>

| FE               | 0                | Failed due to eligibility criteria                      |
| I                |                  | Course Incomplete                                      |

(v) Clause 7 (t) Under the heading Reevaluation and Grade Improvement shall be amended as follows:-
Clause 7 (t): There is no provision for improving the grade. The students can apply for revaluation of the answer books of the end semester examination after the results are declared. The final mark awarded will be the best of the two marks. If the difference in marks obtained in revaluation and the original valuation is more than 15% of the maximum marks, it will be sent for third valuation. The final mark will then be the average of the closest of the two marks obtained in the three valuations to the advantage of the student or the mark obtained in the original valuation whichever is higher. The Controller of Examination shall examine such cases and conduct proper enquiry to see whether any of the examiners has inadvertently responsible for negligent valuation of answer script and recommend for suitable action.

(v) Clause 7(v) under the heading B.Tech Degree, the following is to be added.

The grade card and degree certificate of students admitted under lateral entry scheme will indicate so.

(vi) Clause 7(x) (Last paragraph) shall be amended as follows:

Clause 7(x) (Last Paragraph): In case of malpractices in end semester examinations, the report given by the college DAC and the action taken by the Principal shall be intimated to the Controller of Examination of the University. The Controller of Examinations shall refer the case to the Examination Monitoring Committee. The Controller of Examination will consider the same as a Review.

Trivanathapuram. With the approval of the Executive Committee.

21-4-2016. By Order Registrar.

Note: To be placed in the University Gazette.
In exercise of the Powers conferred under Section 44 and Section 45 of Act 17 of 2015, the following amendments to clauses are incorporated amending certain provisions of the Ordinance for B.Tech/ B.Tech(Hon) dated 26-6-2015 and in the 1st amendment Ordinance dated 21-04-2016.

AMENDMENT ORDINANCE No. 2

1. **Short Title and commencement:** This Ordinance is called Amendment to Ordinance for B.Tech/B.Tech(Hon) dated 26-6-2015 and the 1st Amendment Ordinance as Amendment Ordinance No.2 of 2016. This shall come into force with immediate effect.

   (i) **Clause 2.(a) under the heading Examination** shall be amended as follows:-

   **Clause 2(a).** At the end of the semester, end semester examination will be conducted in all lecture based courses offered in the semester and will normally be of three hours duration, unless otherwise specified. **Supplementary examinations shall be conducted during summer vacation after the even semester examination and before the commencement of the next odd semester, for students who are eligible and have registered for the same.**

   (ii) **Clause 7 (g) under the heading Course Registration and Enrolment** shall be amended as follows:
Clause 7 (g): It is mandatory for students to register for the courses they want to attend in a semester. Students admitted freshly to the first semester, are advised to register for all courses listed for the semester. However they do not have to enroll for the semester. All other students are required to register and enroll for the courses they desire to take in the coming semester. They have to enroll for these courses at the beginning of the new semester, based on the previous semester results. This allows them to make changes in the list of courses already registered for. Before enrolment, students should clear all dues including any fees to be paid and should not have any disciplinary issues pending. The dates for registration and enrolment will be given in the academic calendar. Any late registration or enrolment, allowed up to 7 working days from the stipulated date, will attract a late fee. A student can withdraw from a course or substitute one already registered by another on valid reasons with the approval of the faculty advisor. However this has to be done within seven working days from the commencement of the semester. The maximum number of credits a student can register for in a semester is limited to 28 instead of the 26.

(iii) **Clause 7(l)** under the heading Academic Assessment/Evaluation will be amended and incorporated as follows:

**Academic Evaluation of Courses**

University follows a continuous academic evaluation procedure. Academic evaluation procedure and corresponding weights are as follows:-

a). For theory courses: Normally 1/3rd weightage for internal evaluation and 2/3rd for end semester examination.

For convenience, the maximum marks for internal evaluation and end semester examination for theory courses are fixed as 50 and 100 respectively unless otherwise specified through internal circulars for any particular examination.

(iv) **Clause 7(t)** under the heading Revaluation and Grade Improvement shall be amended and incorporated as follows:

There is no provision for improving the grades. The student can apply for revaluation of the end semester examination after the results are published. The answer scripts already valued by two examiners will not be revalued again.
(v) Clause 7(u) under the heading Grade Cards will be amended and incorporated as follows:

Students who have written the end semester examination will be given the grade cards for the registered courses, in every semester by the University. On earning the required credits for the degree, the University will issue the final consolidated grade sheet for the B. Tech programme including CGPA.

(vi) Amendments and incorporation under the Rules of the Ordinance adding additional clause:

RU: 8 Under the heading Courses to be offered to B. Tech. (Honours) will be added as an additional Rule under the Ordinance:

RU : 8 . To earn 12 additional credits, the student has to take at least four courses of which two should be from the M.Tech specialisation. MOOC courses(massive open online courses) of relevance offered by Institutions of repute are to be identified by the student in consultation with the faculty advisor and get it approved from the University regarding the credits to be allotted. Additionally, there is an option for the student to join the summer projects offered by IISc & IITs.

Thiruvananthapuram. With the approval of the Executive Committee.

1-11-2016 By Order Registrar.

Note : To be placed in the University Gazette.
AMENDMENT ORDINANCE No. 3

1. Short Title and commencement: This Ordinance is called 3rd Amendment to Ordinance for B.Tech/B.Tech(Hon) dated 26-6-2015. This shall come into force with immediate effect.

2. Rule 8 Under the heading Courses to be offered to B.Tech (Honours) shall be amended as follows:

   RU : 8. The Institutions with at least two NBA accredited B.Tech/M.Tech programmes can offer B.Tech (Honours) degree for the students. To earn 12 additional credits, the student has to take at least four courses of which two should be from the M.Tech specialisation. MOOC courses (Massive open online courses) of relevance offered by Institutions of repute are to be identified by the student in consultation with the
Faculty advisor and get it approved from the University regarding the credits to be allotted. Additionally, there is an option for the student to join the summer projects offered by IISc & IITs. If a student after registering for the B.Tech(Honours) programme fails in any course, thereafter, will not be eligible for B.Tech (Honours).

3. Clause 7(h) under the heading “Course completion and Earning of Credits” shall be amended as follows:

Clause 7(h): Under the heading “Course completion and Earning of Credits”, the following condition to be added. For students admitted under lateral entry scheme, credits for the first and second semester courses are deemed to have been earned from the Diploma programme. Their eligibility criteria for registering for higher semester courses will be same as that for the B.Tech programme.

4. Clause 7(m) shall be amended as follows:

Clause 7(m): A student has to earn a minimum number of credits in a semester to be eligible to register for the new courses offered in the next semester. In 1,2&3 semesters if this requirement is not met, the student is to be forewarned and allowed to continue to the next semester. However to register in the 4th, 6th & 8th semesters this requirement will be strictly implemented. Summer courses are offered to those who do not satisfy this norm after the 2nd, as well as 4th, semesters. Students who do not meet this requirement are not permitted to register for new courses in the higher semesters. They have to register for the failed courses in normal semesters in which they are offered subject to the limitations imposed by the ordinances and course timetable.
Action plan, for dealing with course arrears in theory courses at the end of each semester to continue with the programme, is given below. Faculty advisors shall monitor advice and support the students in this. Students should be informed about the minimum cumulative credits requirement to register for higher semester courses.

Eligibility Criteria for Registering for Higher Semester Courses

<table>
<thead>
<tr>
<th>Semester (1)</th>
<th>Allotted credits (2)</th>
<th>Cumulative credits (3)</th>
<th>Minimum cumulative credits required to register for courses in column(1) (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>24</td>
<td>24</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Second</td>
<td>23</td>
<td>47</td>
<td>Not insisted</td>
</tr>
<tr>
<td>Third</td>
<td>24</td>
<td>71</td>
<td>Not insisted</td>
</tr>
<tr>
<td>Fourth</td>
<td>23</td>
<td>94</td>
<td>26 credits from S1&amp;S2</td>
</tr>
<tr>
<td>Fifth</td>
<td>23</td>
<td>117</td>
<td>Not insisted</td>
</tr>
<tr>
<td>Sixth</td>
<td>23</td>
<td>140</td>
<td>71 credits from S1 to S4</td>
</tr>
<tr>
<td>Seventh</td>
<td>22</td>
<td>162</td>
<td>Not insisted</td>
</tr>
<tr>
<td>Eight</td>
<td>18</td>
<td>180</td>
<td>117 credits from S1 to S6</td>
</tr>
</tbody>
</table>

With the approval of the Executive Committee.
Issued By order of Registrar

Thiruvananthapuram
11-05-2017
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Modified Curriculum for B.Tech Degree Semesters I and II 2016

APJ Abdul Kalam Technological University
CET Campus, Thiruvananthapuram
Kerala -695016 India
Phone +91 471 2598122, 2598422
Fax +91 471 2598522 Web: ktu.edu.in
Email: university@ktu.edu.in
# SEMESTER I

<table>
<thead>
<tr>
<th>Slot</th>
<th>Course No.</th>
<th>Subject</th>
<th>L-T-P</th>
<th>Hours</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>MA101</td>
<td>Calculus</td>
<td>3-1-0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>B (1/2)</td>
<td>PH100</td>
<td>Engineering Physics</td>
<td>3-1-0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>CY100</td>
<td>Engineering Chemistry</td>
<td>3-1-0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>C (1/2)</td>
<td>BE100</td>
<td>Engineering Mechanics</td>
<td>3-1-0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>BE110</td>
<td>Engineering Graphics</td>
<td>1-1-3</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>BE101-OX</td>
<td>Introduction to _______ Engineering</td>
<td>2-1-0</td>
<td>3</td>
<td>3</td>
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<tr>
<td>E</td>
<td>BE103</td>
<td>Introduction to Sustainable Engineering</td>
<td>2-0-1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>F (1/4)</td>
<td>CE100</td>
<td>Basics of Civil Engineering</td>
<td>2-1-0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ME100</td>
<td>Basics of Mechanical Engineering</td>
<td>2-1-0</td>
<td>3</td>
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<td>S (1/2)</td>
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<td>Engineering Physics Lab</td>
<td>0-0-2</td>
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<td></td>
<td>CY110</td>
<td>Engineering Chemistry Lab</td>
<td>0-0-2</td>
<td>2</td>
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<tr>
<td>T (2/4)</td>
<td>CE110/ME110/EE110/EC110/CS110/CH110</td>
<td>Basic Engineering Workshops (CS110 for CS and related branches and CH110 for CH and related branches only)</td>
<td>0-0-2 + 0-0-2</td>
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<tr>
<td>U</td>
<td>U100 Language lab/CAD Practice/Bridge courses/Micro Projects etc</td>
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<td>0-0-(2/3)</td>
<td>(2/3)</td>
<td></td>
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<tr>
<td>V</td>
<td>V100 Entrepreneurship/TBI/NCC/NSS/Physical Edn. etc</td>
<td></td>
<td>0-0-2</td>
<td>2</td>
<td>Activity points</td>
</tr>
</tbody>
</table>

Total hours: 30, Total credits: 24/23
Notes:

1. Basic Engineering course of the parent branch included as Introduction to ____________ Engineering. (3 credits)

List of Courses offered under BE 101-OX and Branches associated with each course

1. **BE101-01 Introduction to Civil Engineering**
   - Civil Engineering

2. **BE101-02 Introduction to Mechanical Engineering Sciences**
   - Aeronautical Engineering, Automobile Engineering, Food Technology,
     - Industrial Engineering, Mechanical Engineering, Mechanical Engineering (Automobile), Mechanical Engineering (Production), Mechatronics, Metallurgy,
     - Naval Architecture & Ship Building, Production Engineering.

3. **BE101-03 Introduction to Electrical Engineering**
   - Electrical & Electronics Engineering.

4. **BE101-04 Introduction to Electronics Engineering**
   - Applied Electronics & Instrumentation Engineering, Biomedical Engineering,

5. **BE101-05 Introduction to Computing and Problem Solving**
   - Computer Science & Engineering, Information Technology.

6. **BE101-06 Introduction to Chemical Engineering**
   - Biotechnology/ Biotechnology & Biochemical Engineering, Chemical Engineering,

2. **Institutions can recommend one of four other Basic Engineering courses offered during this semester for every branch.** However, the basic course selected should exclude the one corresponding to their branch of specialization. eg. Student who took Introduction to Civil Engineering should not take Basics of Civil Engineering; student who took Introduction to Electrical Engineering should not take Basics of Electrical Engineering
3. The six basic engineering workshops will be connected with the Introductory or Basics of Engineering courses offered. The students should attend two workshops in Semester 1 and two in Semester 2.

For example, students opting Introduction to Civil Engineering or Basics of Civil Engineering should attend the Civil Engineering Workshop, students opting Introduction to Mechanical Engineering or Basics of Mechanical Engineering should attend the Mechanical Engineering Workshop, students opting Introduction to Chemical Engineering should attend the Chemical Engineering Workshop and students opting Introduction to Computing and Problem Solving should attend the Computer Science Workshop etc. In addition, the students should attend one more workshop course in Semester 1, corresponding to the other Basic Engineering course they had been assigned by the institution. The workshop courses corresponding to both introductory and basic courses are same. However, the institutions may allot exercises or experiments listed in the syllabus based on the contents of corresponding theory course.

4. Engineering Physics and Engineering Chemistry shall be offered in both semesters. Institutions can advise students belonging to about 50% of the number of branches in the institution to opt for Engineering Physics in S1 and Engineering Chemistry in S2 and vice versa. Students opting for Engineering Physics in S1 should attend Engineering Physics Lab in S1 and students opting for Engineering Chemistry in S1 should opt for Engineering Chemistry Lab in S1.

5. Engineering Mechanics and Engineering Graphics shall be offered in both semesters. Institutions can advise students belonging to about 50% of number of branches in the institution to opt for Engineering Mechanics in Semester 1 and Engineering Graphics in Semester 2 and vice versa.

6. It may be noted that for items 4 and 5 above, all students belonging to a particular branch of study must be assigned the same course during one semester. For example, all students belonging to Electrical and Electronics Engineering in an institution may be assigned Engineering Physics and Engineering Physics lab, while all students in Electronics and Communication Engineering branch may be assigned Engineering Chemistry and Chemistry lab. Likewise, all students in Civil Engineering branch may be assigned Engineering Graphics, while all students in Mechanical Engineering branch may be allotted the Engineering Mechanics in Semester 1 and vice versa in Semester 2.
7. For **Course U**, the Institutions should conduct **diagnostic tests** to identify the training requirements of each student and advise them to attend the suitable programme. The students who excel in all diagnostic tests can be assigned **Micro projects** under the guidance of faculty members. The classes for which **BE110 Engineering Graphics** is offered under slot C may be divided into two batches and these batches shall attend CAD Practice lab & Language Lab in alternate weeks.

8. **Course V** is for earning activity points outside academic hours, the details are covered in rules and regulations of KTU.
## Semester II

<table>
<thead>
<tr>
<th>Slot</th>
<th>Course No.</th>
<th>Subject</th>
<th>L-T-P</th>
<th>Hours</th>
<th>Credits</th>
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<td>A</td>
<td>MA102</td>
<td>Differential Equations</td>
<td>3-1-0</td>
<td>4</td>
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<tr>
<td>B</td>
<td>PH100</td>
<td>Engineering Physics</td>
<td>3-1-0</td>
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<td>CY100</td>
<td>Engineering Chemistry</td>
<td>3-1-0</td>
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<tr>
<td>C</td>
<td>BE100</td>
<td>Engineering Mechanics</td>
<td>3-1-0</td>
<td>4</td>
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<tr>
<td></td>
<td>BE110</td>
<td>Engineering Graphics</td>
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<tr>
<td>D</td>
<td>BE102</td>
<td>Design &amp; Engineering</td>
<td>2-0-2</td>
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<tr>
<td>E, F</td>
<td>CE 100</td>
<td>Basics of Civil Engineering</td>
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<td>ME 100</td>
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<td>EE 100</td>
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<tr>
<td></td>
<td>EC 100</td>
<td>Basics of Electronics Engineering</td>
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<tr>
<td></td>
<td>CS 100</td>
<td>Computer Programming (Only for CSE &amp; IT branches)</td>
<td>2-1-0</td>
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<td>S</td>
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<td>Engineering Physics Lab</td>
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<td>Engineering Chemistry Lab</td>
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<td>T</td>
<td>CE110/ME110/EE110/EC110</td>
<td>Basic Engineering Workshops</td>
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<tr>
<td></td>
<td>CS 120</td>
<td>Computer Programming Lab (only for CSE &amp; IT Branches)</td>
<td>0-0-2</td>
<td>2</td>
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<tr>
<td>U</td>
<td>U100 Language lab / CAD Practice / Bridge courses / Micro Projects etc</td>
<td>0-0-(1/2)</td>
<td>(1/2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>V100 Entrepreneurship / TBI/NCC/NSS / Physical Edn. etc</td>
<td>0-0-2</td>
<td>2</td>
<td>Activity points</td>
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</table>

## Total Credits

- **30**
- **24/23**
Note 1: Institutions can assign **two of four** of Basics of Engineering courses not already taken by the student in the previous semester and the corresponding Workshop courses in Semester 2. CS 100 Basics of Computer Programming & CS120 Computer Programming Lab are mandatory for Computer Science & Engineering and Information Technology branches. Other branches are not allowed to opt these courses.

Note 2: **For Course U**, the classes for which BE110 Engineering Graphics is offered under slot C may be divided into two batches and these batches shall attend CAD Practice lab & Language Lab in alternate weeks.

*Note: The Curriculum for Semesters I and II 2015 is slightly modified. The modifications are highlighted in red colour. The modified curriculum will not affect failed students of 2015 batch*
B. Tech. Syllabus
Modified Syllabus for I & II Semester B. Tech. Degree

2016

APJ Abdul Kalam Technological University
CET Campus, Thiruvananthapuram
Kerala -695016 India
Phone +91 471 2598122, 2598422
Fax +91 471 2598522
Web: ktu.edu.in
Email: university@ktu.edu.in
# Table of Contents

<table>
<thead>
<tr>
<th>Code</th>
<th>Subject</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA 101</td>
<td>Calculus</td>
<td>04</td>
</tr>
<tr>
<td>PH 100</td>
<td>Engineering Physics</td>
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<tr>
<td>CY 100</td>
<td>Engineering Chemistry</td>
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<td>BE 100</td>
<td>Engineering Mechanics</td>
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<td>BE 110</td>
<td>Engineering Graphics</td>
<td>15</td>
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<td>BE 101-01</td>
<td>Introduction to Civil Engineering</td>
<td>19</td>
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<tr>
<td>BE 101-02</td>
<td>Introduction to Mechanical Engineering Sciences</td>
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<td>BE 101-03</td>
<td>Introduction to Electrical Engineering</td>
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<td>BE 101-05</td>
<td>Introduction to Computing and Problem Solving</td>
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<td>Introduction to Chemical Engineering</td>
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<td>BE 103</td>
<td>Introduction to Sustainable Engineering</td>
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<td>CY 110</td>
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<tr>
<td>MA 101</td>
<td>CALCULUS</td>
<td>4</td>
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</table>

**Course Objectives**

In this course the students are introduced to some basic tools in Mathematics which are useful in modelling and analysing physical phenomena involving continuous changes of variables or parameters. The differential and integral calculus of functions of one or more variables and of vector functions taught in this course have applications across all branches of engineering. This course will also provide basic training in plotting and visualising graphs of functions and intuitively understanding their properties using appropriate software packages.

**Syllabus**

Single Variable Calculus and Infinite series, Functions of more than one variable, Partial derivatives and its applications, Calculus of vector valued functions, Multiple Integrals.

**Expected outcome**

At the end of the course the student will be able to (i) check convergence of infinite series (ii) find maxima and minima of functions two variables (iii) find area and volume using multiple integrals (iv) apply calculus of vector valued functions in physical applications and (v) visualize graphs and surfaces using software or otherwise.

**Text Books**

1. Anton, Bivens, Davis: Calculus, John Wiley and Sons, 10th ed.

**References:**

<table>
<thead>
<tr>
<th>MODULE</th>
<th>CONTENT</th>
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</table>
| I      | **Single Variable Calculus and Infinite series**  
*Book I – sec 9.3,9.5,9.6,9.8*  
(For practice and submission as assignment only: Sketching, plotting and interpretation of hyperbolic functions using suitable software. Demonstration of convergence of series by software packages) |
| II     | **Partial derivatives and its applications**  
*Book I – sec. 13.3 to 13.5 and 13.8*  
Partial derivatives–Partial derivatives of functions of more than two variables - higher order partial derivatives - differentiability, differentials and local linearity - The chain rule – Maxima and Minima of functions of two variables - extreme value theorem (without proof)-relative extrema |
### FIRST INTERNAL EXAM

<table>
<thead>
<tr>
<th>III</th>
<th>Calculus of vector valued functions (Book I-12.1, 12.2, 12.4 &amp; 12.6, 13.6 &amp; 13.7)</th>
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<tbody>
<tr>
<td></td>
<td>Introduction to vector valued functions-parametric curves in 3-space</td>
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<tr>
<td></td>
<td>Limits and continuity - derivatives - tangent lines – derivative of dot and cross product-</td>
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<tr>
<td></td>
<td>definite integrals of vector valued functions-</td>
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</table>
|     | unit tangent-normal- velocity-acceleration and speed–Normal and tangential components of acceleration.
|     | Directional derivatives and gradients-tangent planes and normal vectors          |
|     | (For practice and submission as assignment only: Graphing parametric curves and surfaces using software packages) |

<table>
<thead>
<tr>
<th>IV</th>
<th>Multiple integrals (Book I-sec. 14.1, 14.2, 14.3, 14.5)</th>
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<tr>
<td></td>
<td>Double integrals- Evaluation of double integrals – Double integrals in non-rectangular coordinates- reversing the order of integration-</td>
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<tr>
<td></td>
<td>Area calculated as a double integral-</td>
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<td>Triple integrals(Cartesian coordinates only)-</td>
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<tr>
<td></td>
<td>volume calculated as a triple integral-</td>
</tr>
<tr>
<td></td>
<td>(applications of results only)</td>
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<table>
<thead>
<tr>
<th>SECOND INTERNAL EXAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topics in vector calculus (Book I-15.1, 15.2, 15.3)</td>
</tr>
<tr>
<td>Vector and scalar fields- Gradient fields –</td>
</tr>
</tbody>
</table>
### V

- Conservative fields and potential functions – divergence and curl - the $\nabla$ operator - the Laplacian $\nabla^2$,
- Line integrals - work as a line integral-
- Independence of path-conservative vector field –

(For practice and submission as assignment only: graphical representation of vector fields using software packages)

<table>
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<tr>
<th>Topics in vector calculus (continued)</th>
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<tbody>
<tr>
<td>(Book I sec., 15.4, 15.5, 15.7, 15.8)</td>
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<tr>
<td>Green’s Theorem (without proof- only for simply connected region in plane),</td>
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<tr>
<td>Surface integrals –</td>
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<tr>
<td>Divergence Theorem (without proof for evaluating surface integrals) ,</td>
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<tr>
<td>Stokes’ Theorem (without proof for evaluating line integrals)</td>
</tr>
<tr>
<td>(All the above theorems are to be taught in regions in the rectangular co ordinate system only)</td>
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</table>

| END SEMESTER EXAM |

Open source software packages such as gnuplot, maxima, scilab ,geogebra or R may be used as appropriate for practice and assignment problems.

**TUTORIALS:** Tutorials can be ideally conducted by dividing each class in to three groups. Prepare necessary materials from each module that are to be taught using computer. Use it uniformly to every class.
Course Objectives
Most of the engineering disciplines are rooted in Physics. In fact a good engineer is more or less an applied physicist. This course is designed to provide a bridge to the world of technology from the basics of science and to equip the students with skills in scientific inquiry, problem solving, and laboratory techniques.

Syllabus

Expected outcome
Familiarity with the principles of Physics and its significance in engineering systems and technological advances.

References:
- Aruldas, G., Engineering Physics, PHI Ltd.
- Beiser, A., Concepts of Modern Physics, McGraw Hill India Ltd.
- Bhattacharya and Tandon, Engineering Physics, Oxford India
- Brijlal and Subramanyam, A Text Book of Optics, S. Chand & Co.
- Dominic and Nahari, A Text Book of Engineering Physics, Owl Books Publishers
- Hecht, E., Optics, Pearson Education
- Mehta, N., Applied Physics for Engineers, PHI Ltd
- Palais, J. C., Fiber Optic Communications, Pearson Education
- Pandey, B. K. and Chathurvedi, S., Engineering Physics, Cengage Learning
- Philip, J., A Text Book of Engineering Physics, Educational Publishers
- Premlet, B., Engineering Physics, Mc Graw Hill India Ltd
- Sarin, A. and Rewal, A., Engineering Physics, Wiley India Pvt Ltd
- Sears and Zemansky, University Physics, Pearson
- Vasudeva, A. S., A Text Book of Engineering Physics, S. Chand & Co
<table>
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<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>Harmonic Oscillations: Differential equation of damped harmonic oscillation, forced harmonic oscillation and their solutions- Resonance, Q factor, Sharpness of resonance- LCR circuit as an electrical analogue of Mechanical Oscillator (Qualitative)</td>
<td>5</td>
<td>15%</td>
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<tr>
<td></td>
<td>Waves: One dimensional wave - differential equation and solution. Three dimensional waves - Differential equation &amp; its solution. (No derivation) Transverse vibrations of a stretched string.</td>
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<td></td>
<td></td>
<td>5</td>
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</tr>
<tr>
<td>IV</td>
<td>Quantum Mechanics: Uncertainty principle and its applications- formulation of Time dependent and Time independent Schrödinger equations- physical meaning of wave function- Energy and momentum Operators-Eigen values and functions- One dimensional infinite square well potential. Quantum mechanical Tunnelling (Qualitative) Statistical Mechanics: Macrostates and Microstates. Phase space. Basic postulates of Maxwell- Boltzmann, Bose-Einstein and Fermi Dirac</td>
<td>6</td>
<td>15%</td>
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<tr>
<td></td>
<td>Statistics. Distribution equations in the three cases (no derivation). Fermi Level and its significance.</td>
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</table>

**SECOND INTERNAL EXAM**

| V  | Acoustics: Intensity of sound- Loudness-Absorption coefficient - Reverberation and reverberation time- Significance of reverberation time- Sabine’s formula (No derivation) -Factors affecting acoustics of a building. | 3 |
|    | Ultrasonics: Production of ultrasonic waves - Magnetostriiction effect and Piezoelectric effect - Magnetostriction oscillator and Piezoelectric oscillator - Detection of ultrasonics - Thermal and piezoelectric methods- Applications of ultrasonics - NDT and medical. | 4 | 20% |

|    | Photonics: Basics of solid state lighting - LED – Photodetectors - photo voltaic cell, junction & avalanche photo diodes, photo transistors, thermal detectors, Solar cells- I-V characteristics - Optic fibre-Principle of propagation-numerical aperture-optic communication system (block diagram) - Industrial, medical and technological applications of optical fibre. Fibre optic sensors - Basics of Intensity modulated and phase modulated sensors. | 5 | 20% |

**END SEMESTER EXAM**
<table>
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<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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<td>CY100</td>
<td>ENGINEERING CHEMISTRY</td>
<td>3-1-0-4</td>
<td>2016</td>
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</table>

**Course Objectives**
To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like new generation engineering materials, storage devices, different instrumental methods etc. And to develop abilities and skills that are relevant to the study and practice of chemistry.

**Syllabus**

**Expected outcome**
The student will be able to apply the knowledge of chemistry and will be equipped to take up chemistry related topics as part of their project works during higher semester of the course.

**References Books:**
- Ahad, J., Engineering Chemistry, Jai Publications
- Dara, S. S., Engineering Chemistry, S Chand Publishers
- Jain and Jain, Engineering Chemistry, Dhanpat Rai Publishers
- Kaurav, Engineering Chemistry with Laboratory Experiments. PHI, ISBN 9788120341746
- Manjooran K. S., Modern Engineering Chemistry, Kannatheri Publication
- Seymour, R. B., Introduction to Polymer Chemistry, McGraw Hill
- Wiley India, Engineering Chemistry, ISBN 9788126543205

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Spectroscopy: Introduction, Beer Lamberts Law (no derivations)(Numericals)</td>
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<tr>
<td></td>
<td>UV-visible spectroscopy - Principle, Instrumentation and applications</td>
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<tr>
<td></td>
<td>IR spectroscopy - Principle and applications (Numericals)</td>
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<tr>
<td></td>
<td>$^1$H NMR spectroscopy - Principle, chemical shift - spin - spin splitting and applications including MRI(brief), Spectral Problems</td>
<td>4</td>
<td></td>
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<tr>
<td>II</td>
<td>Electrochemistry: Different types of electrodes (general) – SHE, Calomel electrode, Glass electrode and determination of $E^0$ using SHE &amp; Calomel</td>
<td>2</td>
<td>15%</td>
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<tr>
<td>Electrode</td>
<td>Electrochemical series and its applications. (Numericals)</td>
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<tr>
<td></td>
<td>Nernst equation - Derivation, application &amp; numericals</td>
<td>2</td>
<td></td>
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<tr>
<td></td>
<td>Potentiometric titration - Acid-base and redox titration</td>
<td>2</td>
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<tr>
<td></td>
<td>Lithium ion cell and Fuel cell.</td>
<td>1</td>
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</tr>
</tbody>
</table>

**FIRST INTERNAL EXAM**

| III | Instrumental Methods: Thermal analysis - Principle, instrumentation and applications of TGA and DTA. | 3 |
|     | Chromatographic methods - Basic principles, column, TLC. Instrumentation and principles of GC and HPLC. | 4 |
|     | Conductivity - Measurement of conductivity                | 1 |

| IV  | Chemistry of Engineering Materials: Copolymers - BS, ABS - Structure and Properties. | 1 |
|     | Conducting Polymers - Polyaniline, Polypyrrole - Preparation, Structure and Properties. | 2 |
|     | OLED – An introduction                                      | 1 |
|     | Advanced Polymers – Kevlar, Polybutadiene rubber and silicone rubber: Preparation, Structure and Properties. | 2 |
|     | Nanomaterials – Definition, Classification, chemical methods of preparation - hydrolysis and reduction | 2 |
|     | Properties and Applications – Carbon Nano Tubes and fullerenes. | 1 |

**SECOND INTERNAL EXAM**

| V   | Fuels and Lubricants: Fuels - Calorific Value, HCV and LCV - Determination of calorific value of a solid and liquid fuel by Bomb calorimeter - Dulong's formula and Numericals. | 3 |
|     | Liquid fuel - Petrol and Diesel - Octane number & CETane number | 1 |
|     | Biodiesel - Natural gas.                                     | 2 |
|     | Lubricant - Introduction, solid, semisolid and liquid lubricants. | 1 |
|     | Properties of lubricants - Viscosity Index, Flash point, Fire point, Cloud point, Pour point and Aniline point. | 2 |

| VI  | Water Technology: Types of hardness, Units of hardness, Estimation of Hardness – EDTA method. Numericals based on the above | 3 |
|     | Water softening methods - Ion exchange process - Principle. Polymer ion exchange. | 2 |
|     | Reverse Osmosis - Disinfection method by chlorination and UV | 1 |
|     | Dissolved oxygen, BOD and COD.                               | 2 |
|     | Sewage water Treatment - Trickling Filter and UASB process.  | 1 |

**END SEMESTER EXAM**
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE100</td>
<td>ENGINEERING MECHANICS</td>
<td>3-1-0-4</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**

1. To apply the principles of mechanics to practical engineering problems.
2. To identify appropriate structural system for studying a given problem and isolate it from its environment.
3. To develop simple mathematical model for engineering problems and carry out static analysis.
4. To carry out kinematic and kinetic analyses for particles and systems of particles.

**Syllabus**

Statics: Fundamental concepts and laws of mechanics; Force systems; Principle of moments; Resultant of force and couple systems; Equilibrium of rigid body; Free body diagram; Equilibrium of a rigid body in three dimension; Support reactions; Properties of surfaces and solids - Centroid, Moment of inertia, Polar moment of inertia, Mass moment of inertia, Product of inertia and Principal moment of inertia; Theorems of Pappus – Guldinus; Friction; Principle of virtual work.

Dynamics: Rectangular and cylindrical coordinate system; Combined motion of rotation and translation; Newton’s second law in rectilinear translation; D’ Alembert’s principle; Mechanical vibration; Simple harmonic motion; Spring-mass model.

**Expected outcome**

1. Students will be able to apply and demonstrate the concepts of mechanics to practical engineering problems.
2. Students will be able to determine the properties of planes and solids.
3. Students will be able to apply fundamental concepts of dynamics to practical problems.

**Text Books:**

- Shames, I. H., Engineering Mechanics - Statics and Dynamics, Pearson Prentice

**References Books:**

- Benjamin J., Engineering Mechanics, Pentex Book Publishers and Distributors
- Bhavikkatti, S. S., Engineering Mechanics, New Age International Publishers
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Statics: Fundamental concepts and laws of mechanics – Rigid body –</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Principle of transmissibility of forces</td>
<td>2</td>
<td>15%</td>
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<tr>
<td></td>
<td>Coplanar force systems - Moment of a force – Principle of moments</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Resultant of force and couple system</td>
<td>4</td>
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<tr>
<td></td>
<td>Equilibrium of rigid body – Free body diagram – Conditions of</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>equilibrium in two dimensions – Two force and three force members.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Types of supports – Problems involving point loads and uniformly</td>
<td>5</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>distributed loads only.</td>
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<tr>
<td></td>
<td>Force systems in space – Degrees of freedom – Free body diagram –</td>
<td>4</td>
<td></td>
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<tr>
<td></td>
<td>Equations of equilibrium – Simple resultant and Equilibrium problems.</td>
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</tr>
</tbody>
</table>

**FIRST INTERNAL EXAM**

| III   | Properties of planar surfaces – Centroid and second moment of area     | 3     | 15%             |
|       | (Derivations not required) - Parallel and perpendicular axis theorem –  |       |                 |
|       | Centroid and Moment of Inertia of composite area.                       |       |                 |
|       | Polar Moment of Inertia – Radius of gyration – Mass moment of inertia  | 2     |                 |
|       | of cylinder and thin disc (No derivations required).                    |       |                 |
|       | Product of inertia – Principal Moment of Inertia (conceptual level).   | 3     |                 |
|       | Theorems of Pappus and Guldinus.                                       | 1     |                 |

**SECOND INTERNAL EXAM**

| IV    | Friction – Characteristics of dry friction – Problems involving friction | 6     | 15%             |
|       | of ladder, wedges and connected bodies.                                 |       |                 |
|       | Definition of work and virtual work – Principle of virtual work for a  | 4     |                 |
|       | system of connection bodies – Problems on determinate beams only.      |       |                 |

**END SEMESTER EXAM**

| V     | Dynamics: Rectangular and Cylindrical co-ordinate system              | 1     |                 |
|       | Combined motion of rotation and translation – Concept of instantaneous|       |                 |
|       | centre – Motion of connecting rod of piston and crank of a reciprocating| 4     | 20%             |
|       | pump.                                                                   |       |                 |
|       | Rectilinear translation – Newton’s second law – D’Alembert’s Principle | 4     |                 |
|       | – Application to connected bodies (Problems on motion of lift only).    |       |                 |
| VI    | Mechanical vibrations – Free and forced vibration - Degree of freedom. | 1     | 20%             |
|       | Simple harmonic motion – Spring-mass model – Period – Stiffness –      | 7     |                 |
|       | Frequency – Simple numerical problems of single degree of freedom.      |       |                 |
Course No: BE110
Course Name: ENGINEERING GRAPHICS
L-T-P Credits: 1-1-3-3
Year of Introduction: 2016

* As this course is practical oriented, the evaluation is different from other lecture based courses.

Points to note:

(1) End semester examination will be for 50 marks and of 3 hour duration.

(2) End semester exam will include all modules except Module IV.

(3) 100 marks are allotted for internal evaluation: first internal exam 40 marks, second internal exam 40 marks (CAD Lab Practice) and class exercises 20 marks.

(4) The first internal exam will be based on modules I and II and the second internal exam will be a practical exam in CAD based on Module IV alone. Second internal exam may be conducted at the end of the semester.

Course Objectives

To enable the student to effectively communicate basic designs through graphical representations as per standards.

Syllabus

Introduction to Engineering Graphics; Orthographic projections of lines and solids, Isometric projection, Freehand sketching, Introduction to CAD, Sections of solids, Development of surfaces, Perspective projection.

Expected outcome

Upon successful completion of this course, the student would have accomplished the following abilities and skills:

1. Fundamental Engineering Drawing Standards.
2. Dimensioning and preparation of neat drawings and drawing sheets.
3. Interpretation of engineering drawings
4. The features of CAD software
References Books:

- Benjamin, J., Engineering Graphics, Pentex Publishers
- Bhatt, N., D., Engineering Drawing, Charotar Publishing House Pvt Ltd.
- Parthasarathy, N. S., and Murali, V., Engineering Drawing, Oxford University Press
- Varghese, P. I., Engineering Graphics, V I P Publishers
- Venugopal, K., Engineering Drawing & Graphics, New Age International Publishers

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>6 exercises</td>
<td>14</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Introduction to Engineering Graphics: Need for engineering drawing.</td>
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<tr>
<td></td>
<td>Drawing instruments; BIS code of practice for general engineering drawing.</td>
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<tr>
<td></td>
<td>Orthographic projections of points and lines:-Projections of points in different quadrants; Projections of straight lines inclined to one of the reference planes, straight lines inclined to both the planes; True length and inclination of lines with reference planes; Traces of lines.</td>
<td></td>
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</tr>
<tr>
<td>II</td>
<td>12 exercises</td>
<td>Orthographic projections of solids:-Projections of simple solids* in simple positions, projections of solids with axis inclined to one of the reference planes and axis inclined to both the reference planes.</td>
<td>11</td>
</tr>
<tr>
<td>III</td>
<td>12 exercises</td>
<td>Isometric Projections:-Isometric projections and views of plane figures simple* and truncated simple* solids in simple position including sphere and hemisphere and their combinations. Freehand sketching: Freehand sketching of real objects, conversion of pictorial views into orthographic views and vice versa.</td>
<td>09</td>
</tr>
<tr>
<td>IV</td>
<td>6 exercises</td>
<td>Introduction to Computer Aided Drafting - familiarizing various coordinate systems and commands used in any standard drafting software - drawing of lines, circle, polygon, arc, ellipse, etc. Creating 2D drawings. Transformations: move, copy, rotate, scale, mirror, offset and array, trim, extend, fillet, chamfer. Dimensioning and text editing. Exercises on basic drafting principles, to create technical drawings. Creation of orthographic views of simple solids from pictorial views. Creation of isometric views of simple solids from orthographic views. Solid modelling and sectioning of solids, extraction of 2D drawings from solid models. (For internal examination only, not for University Examination).</td>
<td>15</td>
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<td>(Additional hours are allotted in U slot for CAD practice)</td>
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<tr>
<td>V</td>
<td>9 exercises</td>
<td>Sections and developments of solids: - Sections of simple* solids in simple vertical positions with section plane inclined to one of the reference planes - True shapes of sections. Developments of surfaces of these solids.</td>
<td>12</td>
</tr>
<tr>
<td>VI</td>
<td>6 exercises</td>
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<tr>
<td></td>
<td>Intersection of surfaces: - Intersection of prism in prism and cylinder in cylinder - axis bisecting at right angles only. Perspective projections: - perspective projections of simple* solids.</td>
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<td></td>
<td>09</td>
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</table>

*Triangular, square, pentagonal and hexagonal prisms, pyramids, cones and cylinders.

END SEMESTER EXAM

Note:
1. First angle projection is to be followed.
2. CAD Practice is mandatory and shall be conducted in the time slot allotted for U slot in addition to 15 hours allotted for Module IV

**Question Paper Pattern:** Question Paper shall contain eight questions of 10 marks each out of which five questions are to be answered as explained below. The duration of examination is 3 hours.

Part A: Three questions from Modules I & II out of which two are to be answered.
Part B: Five questions from Modules III, V & VI out of which three are to be answered.

The questions are to be answered in A4 size booklet containing grid/plain sheets supplied by the university. Drawing sheets are not needed.

The evaluation of answers shall be based on the correctness of solution, judging the knowledge of student in concepts and principles of Engineering Graphics. Accuracy and neatness shall not be criteria for evaluation.
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>BE101-01</td>
<td>INTRODUCTION TO CIVIL ENGINEERING</td>
<td>2-1-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**
1. To provide the students an overview of the profession of Civil Engineering.
2. To give the students an illustration of the use and properties of various building materials and explain the building construction aspects.

**Syllabus**
Civil Engineering as a profession; General introduction to history of Civil Engineering; types and classification of buildings; setting out of a building; Building materials - Stones, Bricks, Tiles, Cement, Aggregate, Cement mortar, Timber, Steel; Building Construction - Stone Masonry, Brick Masonry, Floors and flooring, Roofs and roof coverings.

**Expected outcome**
Students will be able to explain the importance of Civil Engineering in the infrastructural development of the society.
1. They will be able to illustrate the types, uses and properties of various building materials.
2. Students will be able to explain the method of construction of different components of a building.

**References Books:**
- Dalal, K. R., Essentials of Civil Engineering, Charotar Publishing House
- Gopi, S., Basic Civil Engineering, Pearson Publishers
- Kandy, A. A., Elements of Civil Engineering, Charotar Publishing house
- McKay, W. B. and McKay, J. K., Building Construction Volumes 1 to 4, Pearson India Education Services
- Rangwala, S. C. and Dalal, K. B., Building Construction, Charotar Publishing house

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>General introduction to Civil Engineering - History of Civil Engineering - Relevance of Civil Engineering in the overall infrastructural development of the country. Types and classification of structures - buildings, towers, chimneys, bridges, dams, retaining walls, water tanks, silos, roads, railways</td>
<td>2</td>
<td>15%</td>
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19
| Runways and pipelines (Brief description only) |  |
| Definition and types of buildings as per National Building Code of India (brief description only). | 1 |
| Selection of site - Components of a building and their functions - Setting out of a building. | 2 |

**II**

| Stones: Classification of stones - Qualities of good building stones - Quarrying - Dressing - Tests - Specifications - Uses of common building stones. | 2 |
| Bricks: Composition of good brick earth - Classification - Qualities of good bricks - Field and laboratory tests - Specifications. | 2 |
| Tiles: Classification - Manufacture - Properties - Tests - Specifications | 3 |

**FIRST INTERNAL EXAM**

| Cement: Basic Ingredients – Manufacturing process - Grades - Properties - Tests - Specifications. | 4 |
| Aggregates: Fine and coarse aggregate - Properties - Uses - Tests. | 3 |
| Cement Mortar: Types and preparation. | 1 |

**III**

| Stone Masonry: Types - Details of Ashlar, Random Rubble, Coarse Rubble and Dry Rubble Masonry. | 3 |
| Brick Masonry: Types - Bond - Introduction to all types of bonds - English bond in detail (1, 1½ and 2 brick walls) - Comparison of stone and brick masonry. | 4 |

**SECOND INTERNAL EXAM**

| Timber: Properties - Uses - Classification - Seasoning - Defects - Preservation - Tests; Hard board and Particle board - Manufacture and use. | 3 |
| Steel: Structural steel and steel as reinforcement - Types - Properties - Uses - Market forms. | 3 |

**IV**

| Floors and Flooring materials: Different types and selection of floors and floor coverings. | 3 |
| roofs and roof coverings: Different types of roofs - Suitability - Types and selection of roofing materials. | 3 |

**END SEMESTER EXAM**
<table>
<thead>
<tr>
<th>Course No:</th>
<th>Course Name</th>
<th>L-T-P Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>BE101-02</td>
<td>INTRODUCTION TO MECHANICAL ENGINEERING SCIENCES</td>
<td>2-1-0-3</td>
<td>2016</td>
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</tbody>
</table>

**Course Objectives**

1. To introduce different disciplines of Mechanical Engineering  
2. To kindle interest in Mechanical Engineering  
3. To impart basic mechanical engineering principles

**Syllabus**


**Expected Outcome**

At the end of the course, the students will have exposed to the different areas of Mechanical Engineering; gained idea about nature, scope and applications of Mechanical Engineering principles.

**References Books:**

- Dossat, R. J., Principles of Refrigeration, PHI  
- Jain, K. K. and Asthana, R. B., Automobile Engineering, TTTI Bhopal  
- Jonathan Wickert, Introduction to Mechanical Engineering, Cengage Learning  
- Maines, R., Landmarks in Mechanical Engineering, ASME  
- Peng, W. W., Principles of Turbomachinery, John Wiley & Sons  
- Pita, E. G., Air Conditioning Principles & Systems, PHI.  
- Stone, R. and Ball, T. K., Automotive Engineering Fundamentals, SAE International  
- Sutton, G. P. and Ross, D. M., Rocket Propulsion Elements, John Wiley & Sons  
- Von Karman, T., Aerodynamics: Selected Topics in the Light of Their Historical Development, Courier Corporation  
- Online course on Refrigeration & Air conditioning, IIT Kharagpur [www.nptel.ac.in](http://www.nptel.ac.in)
<table>
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<tr>
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<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Thermodynamics:</strong> Nature and scope of thermodynamics; Basic concepts; Laws of thermodynamics- Discovery, Significance &amp; Applications; Qualitative ideas on Entropy; Available energy, Irreversibility, Principle of increase of entropy &amp; Carnot engine; Limitations of Thermodynamics; Sources of power; history of power production; power production in the future.</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Thermal Engineering:</strong> Historical development of steam engine, steam turbines, gas turbines and hydraulic turbines; Principle of turbomachinery; History of IC engines; two stroke and four stroke engines-working, applications; Air compressors- types and uses; Principles of Rocket propulsion, chemical rockets, Indian space programme</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td><strong>Refrigeration &amp; Air Conditioning:</strong> History &amp; scope of refrigeration; applications of refrigeration; Food preservation, refrigerated storage; applications in chemical and process industries; special applications; Air conditioning- Principles &amp; systems; scope of air conditioning; Psychrometric properties of air; Human comfort; comfort standards.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td><strong>Automobile &amp; Aeronautical Engineering:</strong> Introduction to an Automobile; history of the automobile; Indian Automobiles; Types of automobiles; Major components and their functions; Manufacturers of motor vehicles in India; Fundamentals of aerodynamics; drag force and lift force; jet engines types and applications.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td><strong>Engineering Materials:</strong> Introduction and history of materials; Basic crystallography; metals, alloys, composites, ceramics, polymers; mechanical properties and testing of engineering materials.</td>
<td>5</td>
<td>20%</td>
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<tr>
<td>VI</td>
<td><strong>Manufacturing Engineering:</strong></td>
<td>7</td>
<td>20%</td>
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</tbody>
</table>
Methods of manufacturing; casting, forging, rolling, extrusion; machining operations – turning, milling, drilling, grinding, shaping, planing; Joining operations – soldering, brazing & welding; Introduction to CNC machines (elementary idea only); examples of typical products manufactured by above methods.

END SEMESTER EXAM

Question Paper Pattern:

**Part A:** Modules I and II – three questions of 15 marks each – out of which two questions are to be answered.

**Part B:** Modules III and IV – three questions of 15 marks each – out of which two questions are to be answered.

**Part C:** Modules V and VI – three questions of 20 marks each – out of which two questions are to be answered.

Each question can have maximum of four subdivisions (a,b,c,d).
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE101-03</td>
<td>INTRODUCTION TO ELECTRICAL ENGINEERING</td>
<td>2-1-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objective**

The objective of this course is to set a firm and solid foundation in Electrical Engineering with strong analytical skills and conceptual understanding of basic laws and analysis methods in electrical and magnetic circuits.

**Syllabus**

Fundamental Concepts of Circuit Elements and Circuit variables, Real and Ideal independent voltage and current sources, V-I relations; Basic Circuit Laws, Analysis of resistive circuits, Magnetic Circuits, Electromagnetic Induction; Alternating current fundamentals, Phasor Concepts, Complex representation, Phasor analysis of RL, RC, RLC circuit, admittances; Complex Power, Resonance in series and parallel circuits; Three-phase systems, analysis of balanced and unbalanced star and delta connected loads.

**Expected outcome**

The course will enable students to learn advanced topics in Electrical Engineering

**References Books:**

- Bhattacharya, S. K., Basic Electrical & Electronics Engineering, Pearson
- Bird, J., Electrical Circuit Theory and Technology, Routledge, Taylor & Francis Group
- Hughes, Electrical and Electronic Technology, Pearson Education
- Parker and Smith, Problems in Electrical Engineering, CBS Publishers and Distributors
- Sudhakar and Syam Mohan, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill
- Suresh Kumar, K. S, Electric Circuits and Networks, Pearson Education
<table>
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<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Fundamental Concepts of Circuit Elements and Circuit variables: Electromotive force, potential and voltage. Resistors, Capacitors Inductors- terminal V-I relations</td>
<td>1</td>
<td>15%</td>
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<tr>
<td></td>
<td>Electromagnetic Induction: Faraday’s laws, Lenz’s law, statically and dynamically induced EMF, self and mutual inductance, coupling coefficient-energy stored in inductance</td>
<td>2</td>
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<td></td>
<td>Real and Ideal independent voltage and current sources, V-I relations. Passive sign convention</td>
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<td></td>
<td>Numerical Problems (Module I)</td>
<td>2</td>
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<tr>
<td>II</td>
<td>Basic Circuit Laws: Kirchhoff’s current and voltage laws, analysis of resistive circuits-mesh analysis—super mesh analysis</td>
<td>2</td>
<td>15%</td>
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<tr>
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<td>Node analysis-super node analysis, star delta transformation</td>
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<td></td>
<td>Numerical problems (Module II)</td>
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<td><strong>FIRST INTERNAL EXAMINATION</strong></td>
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<tr>
<td>III</td>
<td>Magnetic Circuits: Magnetomotive force, flux, reluctance, permeability -comparison of electric and magnetic circuits, analysis of series magnetic circuits</td>
<td>2</td>
<td>15%</td>
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<tr>
<td></td>
<td>Parallel magnetic circuits, magnetic circuits with air-gaps.</td>
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<tr>
<td></td>
<td>Numerical problems (Module III)</td>
<td>2</td>
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<tr>
<td>IV</td>
<td>Alternating current fundamentals:-Generation of Alternating voltages-waveforms, Frequency, Period, RMS and average values, peak factor and form factor of periodic waveforms (pure sinusoidal) and composite waveforms</td>
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<td>15%</td>
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<td>Topic</td>
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<tr>
<td>Phasor Concepts, Complex representation (exponential, polar and rectangular forms) of sinusoidal voltages and currents phasor diagrams</td>
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<tr>
<td>Complex impedance - series and parallel impedances and admittances, Phasor analysis of RL, RC, RLC circuits</td>
<td>2</td>
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<tr>
<td>Numerical problems, (Module IV)</td>
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**SECOND INTERNAL EXAMINATION**

<table>
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<tr>
<th>Topic</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex Power : Concept of Power factor: active, reactive and apparent power</td>
<td>1</td>
</tr>
<tr>
<td>Resonance in series and parallel circuits</td>
<td>2</td>
</tr>
<tr>
<td>Energy, bandwidth and quality factor, variation of impedance and admittance in series and parallel resonant circuits</td>
<td>2</td>
</tr>
<tr>
<td>Numerical problems (Module V)</td>
<td>2</td>
</tr>
<tr>
<td>Three phase systems: Star and delta connections, three-phase three wire and three-phase four-wire systems</td>
<td>2</td>
</tr>
<tr>
<td>Analysis of balanced and unbalanced star and delta connected loads</td>
<td>2</td>
</tr>
<tr>
<td>Power in three-phase circuits. Active and Reactive power measurement by one, two, and three wattmeter methods</td>
<td>2</td>
</tr>
<tr>
<td>Numerical problems (Module VI)</td>
<td>2</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAMINATION**
Course No. | Course Name | L-T-P-Credits | Year of Introduction
--- | --- | --- | ---
BE101-04 | INTRODUCTION TO ELECTRONICS ENGINEERING | 2-1-0-3 | 2016

Course Objectives
1. To get basic idea about types, specification and common values of passive components
2. To familiarize the working and characteristics of diodes, transistors and MOSFETS
3. To understand working of diodes in circuits and in rectifiers
4. To familiarize some measuring instruments

Syllabus

Expected outcome
Student can identify the active and passive electronic components and can design and setup simple circuits using diodes and transistors. Voltage and currents can be measured and monitored using electronic measuring instruments

References Books:
- Bell, D. A., Electronic Devices and Circuits, Oxford University Press
- Boylested, R. L. and Nashelsky, L., Electronic Devices and Circuit Theory, Pearson Education
- Kal, S., Basic Electronics: Devices, Circuits and its Fundamentals, PHI Learning
- Sedra, A. S. and Smith, K. C., Microelectronic Circuits, Oxford University Press

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Evolution of Electronics, Impact of Electronics in industry and in society.</td>
<td>1</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Resistors, Capacitors: types, specifications. Standard values, marking, colour coding.</td>
<td>3</td>
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<tr>
<td></td>
<td>Inductors and Transformers: types, specifications, Principle of working.</td>
<td>2</td>
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<tr>
<td>Section</td>
<td>Topic</td>
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<tr>
<td>II</td>
<td>Electro mechanical components: relays and contactors.</td>
<td>1</td>
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<tr>
<td></td>
<td>Diodes: Intrinsic and extrinsic semiconductors, PN junction diode, barrier potential, V-I characteristics, Effect of temperature. Equivalent circuit of a diode. Piece wise linear model.</td>
<td>3</td>
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<tr>
<td></td>
<td>Specification parameters of diodes and numbering.</td>
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<td></td>
<td>Zener diode, Varactor diodes, characteristics, working principle of LED, photo diode, solar cell.</td>
<td>3</td>
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<tr>
<td>I</td>
<td><strong>FIRST INTERNAL EXAM</strong></td>
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</tr>
<tr>
<td>III</td>
<td>Bipolar Junction Transistors: Structure, typical doping, Principle of operation, concept of different configurations. Detailed study of input and output characteristics of common base and common emitter configuration, current gain, comparison of three configurations.</td>
<td>3</td>
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<tr>
<td></td>
<td>Concept of load line and operating point. Need for biasing and stabilization, voltage divider biasing, Transistor as amplifier, switch, RC coupled amplifier and frequency response</td>
<td>3</td>
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</tr>
<tr>
<td></td>
<td>Specification parameters of transistors and type numbering</td>
<td>1</td>
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<tr>
<td>IV</td>
<td>Junction Field Effect Transistors: Structure, principle of operation, characteristics, comparison with BJT.</td>
<td>2</td>
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<td></td>
<td>MOSFET: Structure, principle of operation of Enhancement type MOSFET, Current voltage characteristics, Depletion-type MOSFET.</td>
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<tr>
<td></td>
<td>Principle of operation of Photo transistor, UJT, SCR.</td>
<td>3</td>
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<tr>
<td>V</td>
<td><strong>SECOND INTERNAL EXAM</strong></td>
<td>20%</td>
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<tr>
<td></td>
<td>Diode circuits and power supplies: Series and parallel diode circuits, Clippers, Clampers, Voltage multipliers</td>
<td>3</td>
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<td></td>
<td>Half-wave and full wave (including bridge) rectifiers, Derivation of $V_{rms}$, $V_{dc}$, ripple factor, peak inverse voltage, rectification efficiency in each case, capacitor filter, working and design of a simple zener voltage regulator. Block diagram description of a DC Power supply, Principle of SMPS</td>
<td>4</td>
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<tr>
<td>VI</td>
<td>Electronic Measurements and measuring Instruments.</td>
<td>2</td>
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<tr>
<td></td>
<td>Generalized performance parameters of instruments: error, accuracy, sensitivity, precision and resolution. Principle and block diagram of analog and digital multimeter, Block diagram of CRO, Measurements using CRO, Lissajous patterns, Principle and block diagram of DSO, function generator.</td>
<td>4</td>
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<tr>
<td></td>
<td>Testing of Electronic components.</td>
<td>1</td>
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<td></td>
<td><strong>END SEMESTER EXAM</strong></td>
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<tr>
<td>Course No.</td>
<td>Course Name</td>
<td>L-T-P-Credits</td>
<td>Year of Introduction</td>
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<tr>
<td>BE101-05</td>
<td>INTRODUCTION TO COMPUTING AND PROBLEM SOLVING</td>
<td>2-1-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Course Objectives
1. To learn basics of digital computers
2. To develop problem solving skills
3. To learn programming and to solve problems using computers

Syllabus
Introduction to digital computer, Introduction to programming languages, Operating systems, Problem Solving strategies, Examples for algorithms and flow charts, Introduction to Python language, functions, parameters and arguments, Boolean Expressions, logical operators and control statements, Strings, lists, tuples and dictionaries, operations, Files, introduction to objects, attributes and instances

Expected outcome
1. Ability to design algorithmic solution to problems.
2. Ability to convert algorithms to Python programs.
3. Ability to design modular Python programs using functions.
4. Ability to design programs with Interactive Input and Output, utilizing arithmetic expression repetitions, decision making, arrays.
5. Ability to design programs using file Input and Output.
6. Ability to develop recursive solutions.

Text Books:
- Goel, A., Computer Fundamentals, Pearson Education
- Rajaraman, V., Computer Basics and C Programming, Prentice-Hall India

References Books:
- Barry, P., Head First Python, O’Reilly Publishers
- Dromy, R. G., How to solve it by Computer, Pearson India
- Guzdial, M. J., Introduction to Computing and Programming in Python, Pearson India
- Sprinkle, M., Problem Solving & Programming Concepts, Pearson India
- Venit, S. and Drake, E., Prelude to Programming: Concepts & Design, Pearson India
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Introduction to digital computer</strong> – Von Neumann concept – A simple model of computer, acquisition of data, storage of data, processing of data, output of processed data. Details of functional units of a computer. Storage – primary storage and secondary storage. &lt;br&gt;&lt;br&gt;<em>(The discussion should focus more on the functionalities of the units and their interaction than on specific hardware details. However, concepts like memory cells and their addressability (need not be binary), registers, interconnections (buses) have to be introduced at an abstract level. For storage devices – primary and secondary –, various categories have to be introduced along with their distinguishing features. For I-O devices also, various categories are to be introduced. The Von Neumann concept should be effectively introduced. History computers need not be taught. However, students have to be encouraged to read the relevant sections of the text book. Chapters 1 – 4 of ‘Goel’ may be used to support teaching-learning.)</em></td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Problem Solving strategies</strong> – Problem analysis – formal definition of problem – Solution – top-down design – breaking a problem into sub problems- overview of the solution to the sub problems by writing step by step procedure (algorithm) - representation of procedure by flowchart - Implementation of algorithms – use of procedures to achieve modularity. <em>(For this part the instructor has to initially use suitable analogies of real world problems to explain the concepts, before delving into computer-solvable problems.)</em></td>
<td>8</td>
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<td></td>
<td><strong>Examples for algorithms and flow charts</strong> - at least 10 problems (starting</td>
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</table>
with non-numerical examples, and numeric problems like factorial, largest
among three numbers, largest among N, Fibonacci etc.; to be introduced
with progressive levels of difficulty) must be discussed in detail. (Class
assignments and/or tutorials may be used to strengthen understanding of
this part. Chapters 4 and 5 of the ‘Rajaraman’ may be used for the
teaching-learning process.)

<table>
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<tr>
<th>FIRST INTERNAL EXAM</th>
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<tbody>
<tr>
<td><strong>III</strong> Introduction to Python – variables, expressions and statements, evaluation of expressions, precedence, string operations</td>
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<tr>
<td><em>(Note:- the instructor can demonstrate simple programs to the students and encourage them to develop similar ones. In particular, before attempting programs containing functions, the students should be given enough support and time to develop python code containing long sequence of statements for the simple flowcharts developed earlier. This will strengthen the students’ understanding of instruction sequencing. Chapters 1 and 2 of ‘Downey’ have to be covered. Chapter 1 &amp; 2 of ‘Lambert’ can also be used.)</em> Control statements, Boolean expressions and logical operators, conditional and alternative executions <em>(Note: - Chapter 4 of ‘Downey’ up to Section 4.9 has to be covered. The instructor should demonstrate each of these concepts with real examples and encourage students to develop as many as possible. Chapter 3 of ‘Lambert’ can be used for detailed discussion and self-study)</em> Iteration - while statement and tables. <em>(Note: - Chapter 6 of ‘Downey’ has to be covered. Chapter 3 of ‘Lambert’ can be used for detailed discussion and self-study.)</em></td>
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<td>8 15%</td>
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</table>

| **IV** Functions, calling functions, type conversion and coercion, composition of functions, mathematical functions, user-defined functions, parameters and arguments. |
| *(Note: - Chapter 3 of ‘Downey’ has to be covered. The instructor should demonstrate each aspect of the function with real examples and encourage students to develop their own. Chapter 6 (up to 6.3) of ‘Lambert’ can be used for detailed discussion and self-study.)* |
| 6 15% |

<table>
<thead>
<tr>
<th>SECOND INTERNAL EXAM</th>
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</thead>
<tbody>
<tr>
<td><strong>V</strong> Strings and lists – string traversal and comparison with examples.</td>
</tr>
<tr>
<td><em>(Note: - Chapter 7 of ‘Downey’ has to be covered. Section 4.1 of ‘Lambert’ can be used for detailed discussion and self-study.)</em> List operations with examples <em>(Note: - Chapter 8 of ‘Downey’ up to Section 8.6 has to be covered. Section 5.1 of ‘Lambert’ can be used for detailed discussion and self-study.)</em>; tuples and dictionaries – operations and examples *(Note: -</td>
</tr>
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<td>6 20%</td>
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</table>

31
<p>| Chapters 9 &amp; 10 of the third text have to be covered. Section 5.4 of ‘Lambert’ can be used for detailed discussion and self-study. |
| VI Files and exceptions - text files, directories |
| (Note: Chapter 11 of ‘Downey’ has to be covered) |
| Introduction to classes and objects - attributes, instances |
| (Note: Chapter 12 of ‘Downey’ up to Section 12.6 has to be covered) |</p>
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>BE101-06</td>
<td>INTRODUCTION TO CHEMICAL ENGINEERING</td>
<td>2-1-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Course Objectives
1. To instil in students the interest, excitement, and urge to learn the subject of Chemical Engineering
2. To introduce the profession of Chemical Engineering
3. To introduce the purpose of learning important subjects in Chemical Engineering for meeting the requirement of various professional fields in Chemical Engineering.

Syllabus
Introduction to Chemical Engineering, profession, plant operation, Basic concepts of units and equations of state, Overview of unit operations and processes, Modes of heat transfer, chemical reactions, DCDA process, basic concepts of P&I diagram. Introduction to process instrumentation and control, Introduction to safety in chemical process industries, introduction to Environmental Engineering, Challenges of Chemical Engineer, Introduction to novel materials and their development.

Expected outcome
The student will demonstrate the ability to understand the basic concepts of Chemical Engineering

References Books:
- Badger and Banchero, Introduction to Chemical Engineering, McGraw Hill
- McCabe, W. L., Smith, J.C. and Harriott, P., Unit Operations in Chemical Engineering, McGraw Hill
- Pushpavanam, S., Introduction to Chemical Engineering, PHI Learning Pvt. Ltd.
- Smith, R., Chemical Process Design and Integration, Wiley

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to Chemical Engineering: history of Chemical Engineering, role of Chemical Engineering – a broad overview; chemical industries in India; introduction to Chemical Engineering profession; introduction to chemical plant operation; process development and process design.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Basic concepts: units and dimensions, systems of units, conversion and conversion factors of units, concept of mole, weight percent, mole percent, normality, molarity, molality, vapor pressure, partial pressure, concept of ideal gas and equations of state.</td>
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</table>

FIRST INTERNAL EXAM

| III    | Overview of unit operations such as distillation, evaporation, absorption, | 8     | 15%             |
adsorption, extraction, crystallization, drying, leaching, size separation and size reduction. Overview of unit processes like saponification, polymerization, biodiesel formation and hydrogenation.

| IV | Modes of heat transfer-principles of conduction, convection and radiation, heat exchangers. Fluid flow- laminar and turbulent flow. Introduction to transportation of fluids. Classification of chemical reactions, order of reaction, rate equation, Arrhenius equation, conversion and yield, batch reactor, mixed reactor and plug flow reactor. | 8 | 15% |

**SECOND INTERNAL EXAM**

| V | Block diagram, process flow diagram for DCDA process for Sulphuric acid manufacture, basic concepts of P&I diagram. Introduction to process instrumentation and control: common methodologies of measurements, measuring instruments: thermocouple, venturimeter, U-tube manometer, elements of feedback control loop, introduction to control of a distillation column. | 7 | 20% |

| VI | Introduction to safety in chemical process industries – basic concepts, Case study: Bhopal gas tragedy. Introduction to Environmental Engineering - basic concepts, Typical wastewater, air and solid waste management system. Case study: Effect of Aerial Spraying of Endosulfan on Residents of Kasargod, Kerala. Challenges of Chemical Engineer –need for sustainable alternatives for processes; products with environment friendly life-cycle. Introduction to novel materials and their development. | 6 | 20% |

**END SEMESTER EXAM**
<table>
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<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>BE103</td>
<td>INTRODUCTION TO SUSTAINABLE ENGINEERING</td>
<td>2-0-1-3</td>
<td>2016</td>
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</tbody>
</table>

**Course Objectives**
- To have an increased awareness among students on issues in areas of sustainability
- To understand the role of engineering and technology within sustainable development;
- To know the methods, tools, and incentives for sustainable product-service system development
- To establish a clear understanding of the role and impact of various aspects of engineering and engineering decisions on environmental, societal, and economic problems.

**Syllabus**

**Expected outcome**
The student will be
- Able to understand the different types of environmental pollution problems and their sustainable solutions
- Able to work in the area of sustainability for research and education
- Having a broader perspective in thinking for sustainable practices by utilizing the engineering knowledge and principles gained from this course

**Reference Books:**
- Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
### Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Act.</td>
<td>L4</td>
<td>15%</td>
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<tr>
<td></td>
<td>Students may be assigned to do at least one project eg:</td>
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<tr>
<td></td>
<td>a) Identifying/assessment of sustainability in your neighbourhood in education, housing, water resources, energy resources, food supplies, land use, environmental protection etc.</td>
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<td></td>
<td>b) Identify the threats for sustainability in any selected area and explore solutions for the same</td>
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<tr>
<td>II</td>
<td>Air Pollution, Effects of Air Pollution; Water pollution- sources, Sustainable wastewater treatment, Solid waste - sources, impacts of solid waste, Zero waste concept, 3 R concept. Global environmental issues- Resource degradation, Climate change, Global warming, Ozone layer depletion, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon footprint.</td>
<td>L6</td>
<td>15%</td>
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<tr>
<td></td>
<td>Students may be assigned to do at least one project for eg:</td>
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<tr>
<td></td>
<td>a) Assessing the pollution status of a small area</td>
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<td></td>
<td>b) Programmes for enhancing public environmental awareness</td>
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<td></td>
<td>c) Observe a pond nearby and think about the different measures that can be adopted for its conservation</td>
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<tr>
<td>III</td>
<td>Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking, Environment Impact Assessment (EIA) - Procedures of EIA in India.</td>
<td>L4</td>
<td>15%</td>
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<tr>
<td></td>
<td>Students may be assigned to do at least one project eg:</td>
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<tr>
<td></td>
<td>a) Conducting LCA of products (eg. Aluminium cans, PVC bottles, cars etc. or activities (Comparison of land filling and open burning)</td>
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<td></td>
<td>b) Conducting an EIA study of a small project (eg. Construction of a building)</td>
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</table>

**FIRST INTERNAL EXAM**
| IV  | Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification, Methods for increasing energy efficiency of buildings, Sustainable cities, Sustainable transport. Students may be assigned to do at least one project eg:  
  a) Consider the design aspects of a sustainable building for your campus  
  b) Explore the different methods that can be adopted for maintaining a sustainable transport system in your city. |
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<td>L5</td>
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</table>
| V   | Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy. Students may be assigned to do at least one project eg:  
  a) Find out the energy savings that can be achieved by the installation of a solar water heater  
  b) Conduct a feasibility study for the installation of wind mills in Kerala |
|     | L5  | 20% |
| VI  | Green Engineering, Sustainable Urbanisation, industrialisation and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis. Students may be assigned to do a group project eg:  
  a) Collect details for instances of climate change in your locality  
  b) Find out the carbon credits you can gain by using a sustainable transport system (travelling in a cycle or car pooling from college to home)  
  c) Have a debate on the topics like: Industrial Ecology is a Boon or Bane for Industries?/Are we scaring the people on Climate Change unnecessarily?/Technology enables Development sustainable or the root cause of unsustainability? |
|     | L5  | 20% |

END SEMESTER EXAM
<table>
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<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>CE100</td>
<td>BASICS OF CIVIL ENGINEERING</td>
<td>2-1-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**

1. To inculcate the essentials of Civil Engineering field to the students of all branches of Engineering.
2. To provide the students an illustration of the significance of the Civil Engineering Profession in satisfying societal needs.

**Syllabus**

General introduction to Civil Engineering - Introduction to types of buildings, Components of a residential building, Introduction to industrial buildings; Introduction to planning of residential buildings - Simple building plans; Introduction to the various building area terms; Setting out of a building; Surveying – Principles, Objectives, Horizontal measurements with tapes, Ranging; Levelling – Instruments, Reduction of levels; Modern surveying instruments; Building materials – Bricks, cement blocks, Cement, Cement mortar, Steel; Building construction – Foundations, Brick masonry, Roofs, Floors, Decorative finishes, Plastering, Paints and Painting; Basic infrastructure and services – Elevators, Escalators, Ramps, Air conditioning, Sound proofing, Towers, Chimneys, Water Tanks; Intelligent buildings.

**Expected outcome**

1. The students will be able to illustrate the fundamental aspects of Civil Engineering.
2. The students will be able to plan and set out a building.
3. Students will be able to explain the concepts of surveying for making horizontal and vertical measurements.
4. They will able to illustrate the uses of various building materials and explain the method of construction of different components of a building.
5. Students will be able to discuss about various services in a building.

**References Books:**

- Gopi, S., Basic Civil Engineering, Pearson Publishers
- Kandya, A. A., Elements of Civil Engineering, Charotar Publishing house
- McKay, W. B. and McKay, J. K., Building Construction Volumes 1 to 4, Pearson India Education Services
- Minu, S., Basic Civil Engineering, Karunya Publications
- Rangwala, S. C., Essentials of Civil Engineering, Charotar Publishing House

### Course Plan

<table>
<thead>
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<tbody>
<tr>
<td>I</td>
<td>General Introduction to Civil Engineering - Various disciplines of Civil engineering, Relevance of Civil engineering in the overall infrastructural development of the country. Introduction to types of buildings as per NBC; Selection of site for buildings. Components of a residential building and their functions. Introduction to industrial buildings – office / factory / software development office / power house / electronic equipment service centre (any one related to the branch of study) Students have to visit one such building and submit an assignment about the features of any one of the listed building related to their branch (Not included for exam).</td>
<td>2</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Building planning - Introduction to planning of residential buildings- Site plan, Orientation of a building, Open space requirements, Position of doors and windows, Size of rooms; Preparation of a scaled sketch of the plan of a single storeyed residential building in a given site plan. Introduction to the various building area terms - Computation of plinth area / built up area, Floor area / carpet area - for a simple single storeyed building: Setting out of a building.</td>
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**FIRST INTERNAL EXAM**

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<tr>
<td>III</td>
<td>Surveying - Principles and objectives of surveying: Vertical measurements – instruments used – tape, types of tapes; Ranging (direct ranging only) – instruments used for ranging; Levelling - Definitions, principles, Instruments (brief discussion only) - Level field book - Reduction of levels - problems on levelling (height of collimation only). Modern surveying instruments – Electronic distance meter, digital level, total station, GPS (Brief discussion only).</td>
<td>1</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Building materials - Bricks, cement blocks - Properties and specifications.</td>
<td>2</td>
<td>15%</td>
</tr>
<tr>
<td>Topic</td>
<td>Weight</td>
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<tr>
<td>Cement – OPC, properties, grades; other types of cement and its uses (in brief).</td>
<td>1</td>
<td></td>
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<tr>
<td>Cement mortar – constituents, preparation.</td>
<td>1</td>
<td></td>
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<tr>
<td>Concrete – PCC and RCC – grades.</td>
<td>1</td>
<td></td>
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<tr>
<td>Steel - Use of steel in building construction, types and market forms.</td>
<td>1</td>
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<td></td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAM**

<table>
<thead>
<tr>
<th>Section</th>
<th>Topic</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Building construction – Foundations; Bearing capacity of soil (definition only); Functions of foundations, Types - shallow and deep (sketches only).</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Brick masonry – header and stretcher bond, English bonds – Elevation and plan (one brick thick walls only).</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Roofs – functions, types, roofing materials (brief discussion only).</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Floors – functions, types; flooring materials (brief discussion only).</td>
<td>1</td>
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<tr>
<td></td>
<td>Decorative finishes – Plastering – Purpose, procedure.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Paints and Painting – Purpose, types, preparation of surfaces for painting (brief discussion only).</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section</th>
<th>Topic</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI</td>
<td>Basic infrastructure and services - Elevators, escalators, ramps, air conditioning, sound proofing (Civil engineering aspects only)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Towers, Chimneys, Water tanks (brief discussion only).</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Concept of intelligent buildings.</td>
<td>2</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME100</td>
<td>BASICS OF MECHANICAL ENGINEERING</td>
<td>2-1-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**

To expose the students to the thrust areas in Mechanical Engineering and their relevance by covering the fundamental concepts.

**Syllabus**

Thermodynamics, laws of thermodynamics, implications, cycles, energy conversion devices, steam and water machines, engines, turbo machines, refrigeration and air conditioning, power transmission devices in automobiles, latest trends, engineering materials and manufacturing processes, types of materials, alloys, shape forming methods, machine tools.

**Expected outcome**

The student will be able to understand the interdependence of the thrust areas in Mechanical Engineering and their significance leading to the development of products, processes and systems.

**References Books:**

- Balachandran, Basic Mechanical Engineering, Owl Books
- Benjamin, J., Basic Mechanical Engineering, Pentex Books
- Clifford, M., Simmons, K. and Shipway, P., An Introduction to Mechanical Engineering Part I - CRC Press
- Crouse, Automobile Engineering, Tata Mc-Graw-Hill, New Delhi
- Nag, P. K., Basic and Applied Thermodynamics, Tata McGraw-Hill
- Pravin Kumar, Basic Mechanical Engineering
- Sawhney, G. S., Fundamentals of Mechanical Engineering, PHI

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Thermodynamics: Laws of Thermodynamics, significance and Applications of thermodynamics, entropy, Ideal and real gas equations; Analysis of Carnot cycle, Otto cycle, Diesel cycle; Efficiency of these cycles.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Energy conversion devices: Boilers, Steam turbines, Gas turbines; Working principle of two stroke and four stroke I.C.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>Module</td>
<td>Topic</td>
<td>Marks</td>
<td>Percentage</td>
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<tr>
<td>III</td>
<td>Refrigeration and Air Conditioning: Vapour compression refrigeration systems, Heat Pump, COP, Study of household refrigerator, Energy Efficiency Rating, Psychrometry, Psychrometric processes, window air conditioner, split air conditioner. Refrigerants and their impact on environment.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Automobiles and Power Transmission Devices, Different types of automobiles, types of power units in automobiles; major components and their functions (brief description only); Belts and belt drives; Chain drive; Rope drive; Gears and gear trains; friction clutch (cone and single plate), brakes (types and applications only).</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Materials and manufacturing processes: Engineering materials, Classification, properties, Alloys and their Applications; Casting, Sheet metal forming, Sheet metal cutting, Forging, Rolling, Extrusion; Metal joining processes - soldering, brazing and welding; Powder metallurgy. (Elementary ideas only).</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Machine Tools (Basic elements, Working principle and types of operations), Lathe, Drilling Machine, Shaper, planer, slotter, Milling Machine, Grinding machine; Introduction to CNC machines.</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**Question Paper Pattern:**

**Part A:** Modules I and II – three questions of 15 marks each – out of which two questions are to be answered.

**Part B:** Modules III and IV – three questions of 15 marks each – out of which two questions are to be answered.

**Part C:** Modules V and VI – three questions of 20 marks each – out of which two questions are to be answered.

Each question can have maximum of four subdivisions (a,b,c,d).
Course No.  | Course Name                   | L-T-P Credits | Year of Introduction |
-----------|-------------------------------|---------------|----------------------|
EE100      | BASICS OF ELECTRICAL        | 2-1-0-3       | 2016                 |
            | ENGINEERING                  |               |                      |

Course Objectives
To impart a basic knowledge in Electrical Engineering with an understanding of fundamental concepts.

Syllabus
Elementary concepts of electric circuits, Kirchhoff's laws, constant voltage and current sources, Matrix representation; Magnetic circuits, energy stored in magnetic circuits, Electromagnetic induction, Alternating current fundamentals; AC circuits, phasor representation of alternating quantities- rectangular, polar; Three phase systems, star and delta connection; Generation of power, power transmission and distribution; Transformers, Electric Machines-DC Machines, AC Motors.

Expected outcome
The course will enable the students to gain preliminary knowledge in basic concepts of Electrical Engineering.

References Books:
- Bhattacharya, S. K., Basic Electrical & Electronics Engineering, Pearson
- Bird, J., Electrical Circuit Theory and Technology, Routledge, Taylor & Francis Group
- Del Toro, V., Electrical Engineering Fundamentals, Prentice Hall of India.
- Hughes, Electrical and Electronic Technology, Pearson Education
- Mehta, V.K. and Mehta, R., Basic Electrical Engineering, S. Chand Publishing
- Parker and Smith, Problems in Electrical Engineering, CBS Publishers and Distributors
- Sudhakar and Syam Mohan, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill
- Suresh Kumar, K. S, Electric Circuits and Networks, Pearson Education

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Elementary concepts of electric circuits: Kirchhoff's laws, constant</td>
<td>2</td>
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<tr>
<td></td>
<td>voltage and current sources-Problems</td>
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<td></td>
<td>Formation of network equations by mesh current and node voltage methods</td>
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<td>matrix representation-solution of network equations by matrix methods</td>
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<td></td>
<td>problems</td>
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<td></td>
<td>star-delta conversion(resistive networks only-derivation is not needed)</td>
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<tr>
<td></td>
<td>problems</td>
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<tr>
<td>Section</td>
<td>Topic</td>
<td>Numerical Problems</td>
<td>Weightage</td>
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<tr>
<td>II</td>
<td>Magnetic Circuits: MMF, field strength, flux density, reluctance(definition only)-comparison between electric and magnetic circuits</td>
<td>2</td>
<td>15%</td>
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<tr>
<td></td>
<td>Energy stored in magnetic circuits, magnetic circuits with air gap-Numerical problems on series magnetic circuits</td>
<td>2</td>
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<tr>
<td></td>
<td>Electromagnetic Induction: Faraday's laws, lenz's laws- statically induced and dynamically induced emfs-self inductance and mutual inductance, coefficient of coupling (derivation not needed)</td>
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<tr>
<td></td>
<td><strong>FIRST INTERNAL EXAMINATION</strong></td>
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<tr>
<td>III</td>
<td>Alternating Current fundamentals: Generation of alternating voltages-waveforms, frequency, period, average , RMS values and form factor of periodic waveform(pure sinusoidal)- Numerical Problems</td>
<td>2</td>
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<td></td>
<td>AC Circuits: Phasor representation of alternating quantities- rectangular and polar representation</td>
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<tr>
<td></td>
<td>Analysis of simple AC circuits: concept of impedance, power and power factor in ac circuits-active, reactive and apparent power</td>
<td>2</td>
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<td></td>
<td>solution of RL,RC and RLC series circuits-Numerical problems</td>
<td>2</td>
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<tr>
<td></td>
<td>Three phase systems: Generation of three phase voltages- advantages of three phase systems, star and delta connection (balanced only), relation between line and phase voltages, line and phase currents</td>
<td>3</td>
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<td></td>
<td>three phase power measurement by two wattmeter method (derivation is not required) - Numerical problems</td>
<td>1</td>
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<tr>
<td>IV</td>
<td>Generation of power: Block schematic representation of generating stations- hydroelectric power plants</td>
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<td>Block schematic representation of Thermal and nuclear power plants</td>
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<td></td>
<td>Renewable energy sources: solar, wind, tidal and geothermal (Block diagram and working only- No Problems)</td>
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<td></td>
<td>Power transmission: Typical electrical power transmission-(Derivation is not needed, No Problems)</td>
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<td>Power Distribution: substation equipments, primary and secondary transmission and distribution systems- feeder, service</td>
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</table>
## DOWN REACH UNIVERSITY

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### SECOND INTERNAL EXAMINATION

<table>
<thead>
<tr>
<th>V</th>
<th>Electric Machines: DC Generator and Motor - Construction - working principle - Back EMF</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of motor - shunt, series, compound (short and long) - principle of operation of dc motor, applications - numerical problems (voltage - current relations only)</td>
<td>3</td>
<td>20%</td>
</tr>
<tr>
<td>Transformer: Construction of single phase and three phase Transformers (core type only) - EMF equation and related numerical problems</td>
<td>2</td>
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<tr>
<td>Losses and efficiency of transformer for full load - numerical problems (no equivalent circuit)</td>
<td>2</td>
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</tbody>
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<thead>
<tr>
<th>VI</th>
<th>AC Motors: Three phase induction motor - squirrel cage and slip ring induction motor</th>
<th>1</th>
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<tbody>
<tr>
<td>Working principle - synchronous speed, slip and related numerical problems (no equivalent circuit)</td>
<td>1</td>
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</tr>
<tr>
<td>AC Motors: Construction, principles of operation of single phase induction motor (no equivalent circuit)</td>
<td>1</td>
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<tr>
<td>Starting methods in single phase induction motors - split phase and capacitor start</td>
<td>2</td>
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</tbody>
</table>

### END SEMESTER EXAMINATION
**Course No:** EC100  
**Course Name:** BASICS OF ELECTRONICS ENGINEERING  
**L-T-P Credits:** 2-1-0-3  
**Year of Introduction:** 2016

**Course Objectives**

1) To get basic idea about types, specification and common values of passive and active components.

2) To familiarize the working of diodes, transistors, MOSFETS and integrated circuits.

3) To understand the working of rectifiers, amplifiers and oscillators.

4) To get a basic idea about measuring instruments.

5) To get a fundamental idea of basic communication systems and entertainment electronics.

**Syllabus**


**Expected Outcome**

Student can identify the active and passive electronic components. Student can setup simple circuits using diodes and transistors. Student will get fundamental idea about basic communication systems and entertainment electronics.

**Text Books:**

- Bell, D. A., Electronic Devices and Circuits, Oxford University Press
- Tomasy, W., Advanced Electronic Communication system, PHI Publishers

**References Books:**

- Boylested, R. L. and Nashelsky, L., Electronic Devices and Circuit Theory, Pearson Education
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Evolution of Electronics, Impact of Electronics in industry and in society.</td>
<td>1</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Resistors, Capacitors: types, specifications. Standard values, marking, colour coding.</td>
<td>3</td>
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<tr>
<td></td>
<td>Inductors and Transformers: types, specifications, Principle of working.</td>
<td>2</td>
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<td></td>
<td>Electro mechanical components: relays and contactors.</td>
<td>1</td>
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<tr>
<td>II</td>
<td>PN Junction diode: Intrinsic and extrinsic semiconductors, Principle of operation, V-I characteristics, principle of working of Zener diode, Photo diode, LED and Solar cell.</td>
<td>4</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, input and output characteristics of common emitter configuration (npn only).</td>
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<td><strong>FIRST INTERNAL EXAM</strong></td>
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<tr>
<td>III</td>
<td>Rectifiers and power supplies: Block diagram description of a dc power supply, Half wave and full wave (including bridge) rectifier, capacitor filter, working of simple zener voltage regulator.</td>
<td>4</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Amplifiers and Oscillators: Circuit diagram and working of common emitter amplifier, Block diagram of Public Address system, concepts of feedback, working principles of oscillators, circuit diagram &amp; working of RC phase shift oscillator.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Analogue Integrated circuits: Functional block diagram of operational amplifier, ideal operational amplifier, inverting and non-inverting Amplifier.</td>
<td>3</td>
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<tr>
<td></td>
<td>Digital ICs: Logic Gates.</td>
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<tr>
<td></td>
<td>Electronic Instrumentation: Principle and block diagram of digital multimeter, digital storage</td>
<td>2</td>
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</table>
oscilloscope, and function generator.

<table>
<thead>
<tr>
<th>SECOND INTERNAL EXAM</th>
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<tbody>
<tr>
<td><strong>V</strong></td>
</tr>
<tr>
<td><strong>Radio communication:</strong> principle of AM &amp; FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver.</td>
</tr>
<tr>
<td><strong>Satellite communication:</strong> concept of geo-stationary Satellite system.</td>
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<td><strong>VI</strong></td>
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<tr>
<td><strong>Mobile communication:</strong> basic principles of cellular communications, concepts of cells, frequency reuse.</td>
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<tr>
<td><strong>Optical communication:</strong> block diagram of the optical communication system, principle of light transmission through fiber, advantages of optical communication systems.</td>
</tr>
<tr>
<td><strong>Entertainment Electronics Technology:</strong> Basic principles and block diagram of cable TV, CCTV, DTH system.</td>
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</table>

**END SEMESTER EXAM**

Note: Analysis is not required in this course.
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
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<tbody>
<tr>
<td>MA102</td>
<td>DIFFERENTIAL EQUATIONS</td>
<td>3-1-0-4</td>
<td>2016</td>
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</tbody>
</table>

Course Objectives

This course introduces basic ideas of differential equations, both ordinary and partial, which are widely used in the modelling and analysis of a wide range of physical phenomena and has got applications across all branches of engineering. The course also introduces Fourier series which is used by engineers to represent and analyse periodic functions in terms of their frequency components.

Syllabus

Homogeneous linear ordinary differential equation, non-homogeneous linear ordinary differential equations, Fourier series, partial differential equation, one dimensional wave equation, one dimensional heat equation.

Expected Outcome

At the end of the course students will have acquired basic knowledge of differential equations and methods of solving them and their use in analysing typical mechanical or electrical systems. The included set of assignments will familiarise the students with the use of software packages for analysing systems modelled by differential equations.

TEXT BOOKS


REFERENCES:

- Simmons: Differential Equation with Applications and its historical Notes, 2e McGrawHill Education India 2002
## COURSE PLAN

<table>
<thead>
<tr>
<th>COURSE NO: MA102</th>
<th>L-T-P:3-1-0</th>
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<tbody>
<tr>
<td>COURSE NAME: DIFFERENTIAL EQUATIONS</td>
<td>CREDITS:4</td>
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<table>
<thead>
<tr>
<th>MODULE</th>
<th>CONTENT</th>
<th>HRS</th>
<th>END SEM. EXAM MARKS (OUT OF 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>HOMOGENEOUS DIFFERENTIAL EQUATIONS (Text Book 1: Sections 1.7, 2.1, 2.2, 2.6, 3.2) Existence and uniqueness of solutions for initial value problems, Homogenous linear ODEs of second order. Homogenous linear ODEs with constant coefficients, Existence and Uniqueness of solutions Wronskian, Homogenous linear ODEs with constant Coefficients (Higher Order) (For practice and submission as assignment only: Modelling of free oscillations of a mass – spring system)</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>NON-HOMOGENEOUS LINEAR ORDINARY DIFFERENTIAL EQUATIONS ( Text Book 2: Sections 1.2.7 to 1.2.14) The particular Integral (P.I.), Working rule for P.I. when ( g(x) = x^m ), To find P.I. when ( g(x) = e^{ax} ).V(x), Working rule for P.I. when ( g(x) = x.V(x) ), Homogeneous Linear Equations, PI of Homogenous equations Legendre's Linear equations Method of variation of parameters for finding PIs (For practice and submission as assignments only: Modelling forced oscillations, resonance, electric circuits)</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>III</td>
<td>FOURIER SERIES (Text Book 2 - Sections 4.1,4.2,4.3,4.4) Periodic functions,Orthogonally of Sine and Cosine functions (Statement only), Fourier series and Euler’s formulas Fourier cosine series and Fourier sine series (Fourier series of even and Odd functions ) Half range expansions (All results without proof)</td>
<td>3</td>
<td>3</td>
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<thead>
<tr>
<th>END SEMESTER EXAM</th>
<th>TUTORIALS: Tutorials can be ideally conducted by dividing each class into three groups. Prepare necessary materials from each module that can be practiced using computer software. Use them uniformly in every class.</th>
<th>ONE DIMENSIONAL HEAT EQUATION (Text Book 2: sections 6.7, 6.8, 6.9, 6.10)</th>
<th>ONE DIMENSIONAL WAVE EQUATION (Text Book 2: Sections 6.1 - 6.4)</th>
<th>PARTIAL DIFFERENTIAL EQUATIONS (Text Book 2: Sections: 5.1, 5.1.1, 5.1.2, 5.1.5, 5.2.6, 5.2.10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Solutions of One Dimensional Heat transfer equation.</td>
<td>Method of separation of variables and problems</td>
<td>Linear PDE with constant coefficients.</td>
<td>Plots of partial sums of Fourier series and demonstrations of convergence using plotting software.</td>
</tr>
<tr>
<td>V</td>
<td>One dimensional Heat transfer equation.</td>
<td>Solutions of one dimensional wave equation using method of separation of variables</td>
<td>Solutions of Linear Homogenous PDE with constant coefficients.</td>
<td>Only</td>
</tr>
<tr>
<td>V</td>
<td>A long uninsulated rod with ends at zero temperatures.</td>
<td>Vibration of a stretched string</td>
<td>Method of finding PI when $g(x,y) = f(x,y)$.</td>
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</tr>
<tr>
<td>V</td>
<td>The equation of Heat conduction.</td>
<td>Solutions of one dimensional wave equation using method of separation of variables and problems</td>
<td>Method of finding PI when $g(x,y) = e^{ax+by}$.</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>The wave equation</td>
<td>A long insulated rod with ends at non-zero temperatures.</td>
<td>Shorter method for finding PI when $g(x,y) = x^m y^n$.</td>
<td></td>
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<tr>
<td>V</td>
<td>Lagrange’s Method</td>
<td></td>
<td>Method of finding PI when $g(x,y) = e^{ax+by}$.</td>
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For practice and submission as assignment only:
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<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE102</td>
<td>DESIGN AND ENGINEERING</td>
<td>2-0-2-3</td>
<td>2016</td>
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</tbody>
</table>

**Course Objectives**
The purpose of this course is:-
1. To excite the student on creative design and its significance;
2. To make the student aware of the processes involved in design;
3. To make the student understand the interesting interaction of various segments of humanities, sciences and engineering in the evolution of a design;
4. To get an exposure as to how to engineer a design.

**Syllabus**
Design and its objectives; Role of science, engineering and technology in design; Engineering as a business proposition; Creative design and the Design Process; Design evaluation and communication of designs; Design for function and strength; Material selection and design detailing; Role of standards in design Engineering the design; Design for “X”; Product centered and user centered design; Aesthetics and ergonomics; Concepts of value engineering, concurrent engineering and reverse engineering in design; Culture based design; Modular design; Design optimization needs; User interface; Intelligent and autonomous products; Internet of things; Advanced products and human psychology; Life cycle design; Product and its environment; Design as a marketing tool; Products and IPR; Product liability.

**Expected outcome**
The student will be:-
- Able to appreciate the different elements involved in good designs and to apply them in practice when called for.
- Aware of the product oriented and user oriented aspects that make the design a success.
- Will be capable to think of innovative designs incorporating different segments of knowledge gained in the course;
- Students will have a broader perspective of design covering function, cost, environmental sensitivity, safety and other factors other than engineering analysis.

**References Books:**

Web pages:
1. E-Book (Free download): [http://opim.wharton.upenn.edu/~ulrich/designbook.html](http://opim.wharton.upenn.edu/~ulrich/designbook.html)
2. [http://www2.warwick.ac.uk/fac/sci/wmg/ftmse/modules/modulelist/peuss/designforx/design_for_x_notes_section_5.pdf](http://www2.warwick.ac.uk/fac/sci/wmg/ftmse/modules/modulelist/peuss/designforx/design_for_x_notes_section_5.pdf)

### Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Design and its objectives; Design constraints, Design functions, Design means and Design from; Role of Science, Engineering and Technology in design; Engineering as a business proposition; Functional and Strength Designs. Design form, function and strength; How to initiate creative designs? Initiating the thinking process for designing a product of daily use. Need identification; Problem Statement; Market survey-customer requirements; Design attributes and objectives; Ideation; Brain storming approaches; arriving at solutions; Closing on to the Design needs. An Exercise in the process of design initiation. A simple problem is to be taken up to examine different solutions- Ceiling fan? Group Presentation and discussion.</td>
<td>L2</td>
<td>15%</td>
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<tr>
<td>II</td>
<td>Design process- Different stages in design and their significance; Defining the design space; Analogies and “thinking outside of the box”; Quality function deployment-meeting what the customer wants; Evaluation and choosing of a design. Design Communication; Realization of the concept into a configuration, drawing and model. Concept of “Complex is Simple”. Design for function and strength. Design detailing- Material selection, Design visualisation- Solid modelling; Detailed 2D drawings; Tolerancing; Use of standard items in design; Research needs in design; Energy needs of the design, both in its realization and in the applications. An exercise in the detailed design of two products (Stapler/ door/clock)</td>
<td>L2</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Prototyping- rapid prototyping; testing and evaluation of design; Design modifications; Freezing the design; Cost analysis. Engineering the design – From prototype to product. Planning; Scheduling; Supply chains; inventory; handling;</td>
<td>L2</td>
<td>15%</td>
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<td>L3</td>
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<tr>
<td></td>
<td>manufacturing/construction operations;</td>
<td>storage;</td>
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<td></td>
<td>packaging; shipping; marketing; feed-back on design.</td>
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<tr>
<td></td>
<td>List out the standards organizations.</td>
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<td></td>
<td>Prepare a list of standard items used in any engineering specialization.</td>
<td></td>
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<tr>
<td></td>
<td>Develop any design with over 50% standard items as parts.</td>
<td>P4</td>
<td></td>
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<tr>
<td>IV</td>
<td>Design for “X”; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling; disassembly; recycling; re-engineering etc.</td>
<td>L4</td>
<td></td>
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<tr>
<td></td>
<td>List out the design requirements(x) for designing a rocket shell of 3 meter diameter and 8 meter length.</td>
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<tr>
<td></td>
<td>Design mineral water bottles that could be packed compactly for transportation.</td>
<td>P4</td>
<td></td>
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<tr>
<td></td>
<td><strong>SECOND INTERNAL EXAM</strong></td>
<td></td>
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<tr>
<td>V</td>
<td>Product centred and user centred design. Product centred attributes and user centred attributes. Bringing the two closer. Example: Smart phone. Aesthetics and ergonomics.</td>
<td>L2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Value engineering, Concurrent engineering, Reverse engineering in design; Culture based design; Architectural designs; Motifs and cultural background; Tradition and design; Study the evolution of Wet grinders; Printed motifs; Role of colours in design.</td>
<td>L4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Make sharp corners and change them to smooth curves-check the acceptance. Examine the possibility of value addition for an existing product.</td>
<td>P6</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Modular design; Design optimization; Intelligent and autonomous products; User interfaces; communication between products; autonomous products; internet of things; human psychology and the advanced products. Design as a marketing tool; Intellectual Property rights – Trade secret; patent; copy-right; trademarks; product liability.</td>
<td>L3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group presentation of any such products covering all aspects that could make or mar it.</td>
<td>P6</td>
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</table>

**END SEMESTER EXAM**

**Evaluation Scheme:**

First internal exam – closed book exam – 25 marks

Second internal exam – open book exam – 25 marks

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54
Assignment/projects – 50 marks (iv) End semester exam – open book exam – 50 marks (2 hours duration – conducted by the University)

First Test: Marks: 25 Closed Book:

Questions may cover:-

Topics covered in the lectures.
How to arrive at the design details for a specific need gap given.
Sketching the design of a product that is to meet the given user requirements.

Second Test: Marks: 25 Open Book:

Students are permitted to bring in class notes, own notes, text books and other books (Maximum 3/4 books) for the test. Access to internet and mobile phones is NOT permitted.

Assignments: Marks: 20 Two assignments are to be given (10 marks each). These assignments are to cover specific design/s, sketching of the design, and a short but well written write-up on the design.

Projects: Marks: 30 Two mini projects are to be assigned. One is to be a group project and the other an individual one. A group of 3 or 4 students can take up the group project. Each project is to be evaluated for 15 marks.

The Group Project is to be done in the practical hours given for the course. Projects including the group projects are to be evaluated based on individual presentations and answers to the questions raised. These presentations could be done during the practical hours.

Question Paper Pattern for End Semester Examination (Open Book)

Part A – Eight questions of each 5 marks, out of which six questions are to be answered.

Part B – Three questions of each 10 marks, out of which two questions are to be answered.
Course Objectives

This course is designed (i) to impart practical knowledge about some of the phenomena they have studied in the Engineering Physics course and (ii) to develop the experimental skills of the students.

List of Exercises / Experiments (Minimum of 8 mandatory)

Basics
1. Study of application of Cathode Ray Oscilloscope (CRO) for Frequency and Amplitude measurements. Lissajous figures (useful for different types of polarized light.)
2. Temperature measurement – Thermocouple

Waves, Oscillations and Ultrasonics
4. Wave length and velocity measurement of ultrasonic waves in a liquid using ultrasonic diffractometer.
5. The LCR Circuit – Forced and damped harmonic oscillations.

Interference
7. Wave length measurement of a monochromatic source of light using Newton’s Rings method.
9. Determination of diameter of a thin wire or thickness of a thin strip of paper using air wedge method.

Diffraction
10. To determine the slit or pinhole width.
11. To measure wavelength using a millimeter scale as a grating.
12. Determination the wavelength of He-Ne laser or any standard laser using diffraction grating.
13. To determine the wavelength of monochromatic light using grating.
14. Determination of dispersive power and resolving power of a plane transmission grating.
**Polarisation**

15. Kerr Effect - To demonstrate the Kerr effect in nitrobenzene solution and to measure the light intensity as a function of voltage across the Kerr cell using photo detector.

16. To measure the light intensity of plane polarised light as a function of the analyzer position.

17. Laurent’s Half Shade Polarimeter - To observe the rotation of the plane of polarization of monochromatic light by sugar solution and hence to determine the concentration of solution of optically active substance.

**Laser & Photonics**

18. To determine the speed of light in air using laser.

19. Calculate the numerical aperture and study the losses that occur in optical fiber cable.

20. Determination of the particle size of lycopodium powder.

21. I-V characteristics of solar cell

22. To measure Planck’s constant using photo electric cell.


**Reference Books:**

- Gupta, S. K., Engineering Physics Practicals, Krishna Prakashan Pvt. Ltd.
- Koser, A. A., Practical Engineering Physics, Nakoda Publishers and Printers India Ltd
- Sasikumar, P. R. Practical Physics, PHI.

**Website:**

- http://www.indosawedu.com
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>CY 110</td>
<td>ENGINEERING CHEMISTRY LAB</td>
<td>0-0-2-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**List of Exercises / Experiments (Minimum of 8 mandatory)**

1. Estimation of Total Hardness – EDTA method.
3. Estimation of Copper in Brass.
4. Estimation of dissolved oxygen by Winklers method.
5. Estimation of chloride in water.
6. Preparation of Urea formaldehyde and Phenol-formaldehyde resin.
7. Determination of Flash point and Fire point of oil by Pensky Martin Apparatus.
8. Determination of wavelength of absorption maximum and colorimetric estimation of $\text{Fe}^{3+}$ in solution.
9. Determination of molar absorptivity of a compound other than $\text{Fe}^{3+}$.
10. Analysis of IR spectra of any three organic compounds.
11. Analysis of $^1\text{H}$ NMR spectra of any three organic compounds.
13. Verification of Nernst equation for electrochemical cell.
14. Potentiometric titrations: acid – base and redox titrations
15. Conductivity measurements of salt solutions.
16. Flame photometric estimation of Na$^+$ to find out the salinity in sand.

**Expected outcome**

The student will be able to apply and demonstrate the theoretical concepts of Engineering Chemistry.

**References:**
- Practical Engineering Chemistry Lab Manual, Owl book publishers
<table>
<thead>
<tr>
<th>Course No.</th>
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<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>CE110</td>
<td>CIVIL ENGINEERING WORKSHOP</td>
<td>0-0-2-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

List of Exercises / Experiments (Minimum of 8 mandatory)
(For Civil Engineering Branch)

Setting out of a building: The student should set out a building (single room only) as per the given building plan using tape only.

Setting out of a building: The student should set out a building (single room only) as per the given building plan using tape and cross staff.

Construct a wall of height 50 cm and wall thickness 1½ bricks using English bond (No mortar required) - corner portion = length of side walls 60 cm.

Construct a wall of height 50 cm and wall thickness 2 bricks using English bond (No mortar required) - corner portion = length of side walls 60 cm.

Compute the area and/or volume of various features of a building/structure such as door and window size, number of bricks required to construct a wall of a building, diameter of bars used in windows etc. – To create an awareness of measurements and units (use tape or other simple measuring instruments like vernier caliper, screw gauge etc.).

Testing of building materials: The student should do the compression testing of any three construction materials and compare the strength (brick, hollow block, laterite block, cement concrete cube, stone block, and so on).

Computation of Centre of gravity and Moment of inertia of a given rolled steel section by actual measurements.

Introduction to simple plumbing and sanitary fittings.

Home assignment 1: Preparation of a building model - The students in batches should prepare and submit a building model for a given plinth area in a given site plan constrained by a boundary wall. The minimum requirements of a residential building viz., drawing cum dining room, one bed room and a kitchen should be included. The concept of an energy efficient building should also be included in the model.

Home assignment 2: Report preparation - The student should collect the construction details of any one unique Civil Engineering structure, prepare and submit a detailed report with neat illustrations.

Home assignment 3: Report preparation - The students should collect samples of building materials, prepare and submit a detailed report including their market rates.

(For branches other than Civil Engineering)

Setting out of a building: The student should set out a building (single room only) as per the given building plan using tape only.

Setting out of a building: The student should set out a building (single room only) as per the
given building plan using tape and cross staff.

Building area computation: The student should prepare a rough sketch of a given single storeyed building and by taking linear measurements compute plinth area and carpet area of the given building.

Construct a wall of at least a height of 500mm and wall thickness 1brick using English bond (No mortar required) - corner portion – length of side walls at least 600mm.

Compute the area and/or volume of various features of a building/structure such as door and window size, number of bricks required to construct a wall of a building, diameter of bars used in windows etc. – To create an awareness of measurements and units (use tape or other simple measuring instruments like vernier calipers, screw gauge etc.).

Horizontal measurements: Find the area of an irregular polygon set out on the field.

Vertical measurements: Find the level difference between any two points.

Computation of Centre of gravity and Moment of inertia of a given rolled steel section by sketching and measurements.

Home assignment 1: Preparation of a building model - The students in batches should prepare and submit a building model for a given plinth area in a given site plan constrained by a boundary wall. The minimum requirements of a residential building viz., drawing cum dining room, one bed room and a kitchen should be included. The concept of an energy efficient building should also be included in the model.

Home assignment 2: Report preparation - The student should collect the construction details of an industrial building related to their branch of study, prepare and submit a detailed report with neat illustrations.

Home assignment 3: Report preparation - The students should collect samples of building materials, prepare and submit a detailed report about their market rates.
<table>
<thead>
<tr>
<th>Sl. Name of Shop floor</th>
<th>Exercises</th>
<th>No of sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td>Studies of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc. And accessories (b) Components: Bearings, seals, O-rings, circlips, keys etc.</td>
<td>1</td>
</tr>
<tr>
<td><strong>Carpentry</strong></td>
<td>Any one model from the following: 1. T-Lap joint 2. Cross lap joint 3. Dovetail joint 4. Mortise joint (a) Demonstrating the forgability of different materials (MS, Al, Alloy steel and Cast steel) in cold and hot states. (b) Observing the qualitative differences in the hardness of these materials (c) Determining the shape and dimensional variations of Al test specimen due to forging under different states by visual inspection and measurements</td>
<td>2</td>
</tr>
<tr>
<td><strong>Smithy</strong></td>
<td>Any one exercise from the following 1. Bench moulding 2. Floor moulding 3. Core making</td>
<td>2</td>
</tr>
<tr>
<td><strong>Foundry</strong></td>
<td>Any one exercise from the following 1. Cylindrical 2. Conical 3. Prismatic shaped jobs from sheet metal</td>
<td>2</td>
</tr>
<tr>
<td><strong>Sheet Metal</strong></td>
<td>Any one exercise from the following Making joints using Electric arc welding. Bead formation in horizontal, vertical and overhead positions</td>
<td>2</td>
</tr>
<tr>
<td><strong>Welding</strong></td>
<td>Filing exercise and any one of the following exercises Disassembling and reassembling of 1. Cylinder piston assembly 2. Tail stock assembly 3. Time piece/clock 4. Bicycle or any machine.</td>
<td>2</td>
</tr>
<tr>
<td><strong>Fitting and Assembly</strong></td>
<td>Demonstration and applications of Drilling machine, Grinding machine, Shaping machine, Milling machine and lathe</td>
<td>2</td>
</tr>
<tr>
<td>Course No.</td>
<td>Course Name</td>
<td>L-T-P-Credits</td>
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<tr>
<td>EE110</td>
<td>ELECTRICAL ENGINEERING WORKSHOP</td>
<td>0-0-2-1</td>
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</table>

**Course Objectives**

The objective of this course is to familiarize the students with commonly used components, accessories and measuring equipment in Electrical installations. The course also provides hands on experience in setting up of simple wiring circuits.

**List of Exercises / Experiments (Minimum of 8 mandatory)**

1. Identify different types of cables/wires and switches and their uses.
2. Identify different types of fuses & fuse carriers, MCB and ELCB, MCCB with ratings and usage.
3. Wiring of simple light circuit for controlling light/fan point (PVC conduit wiring).
4. Wiring of light/fan circuit using Two way switches (Staircase wiring)
5. Wiring of fluorescent lamps and light sockets (6 A)
6. Wiring of Power circuit for controlling power device (16A socket)
7. Godown wiring / Tunnel wiring
8. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, Main switch and Energy meter.
10. Wiring of backup power supply including inverter, battery and load for domestic installations.
11. Demonstration and measurement of power consumption of electric iron, mixer grinder, single phase pump, exhaust fan, etc.
12. Energy meter reading and tariff calculation

**Expected outcome**

1. Familiarity with supply arrangements and their limitations, knowledge of standard voltages and their tolerances, safety aspects of electrical systems and importance of protective measures in wiring systems.
2. Knowledge about the types of wires, cables and other accessories used in wiring. Creating awareness of energy conservation in electrical systems.
3. Students should be able to wire simple lighting circuits for domestic buildings, distinguish between light and power circuits.
4. To measure electrical circuit parameters and current, voltage and power in a circuit.
5. Familiarity with backup power supply in domestic installation.
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>EC110</td>
<td>ELECTRONICS ENGINEERING WORKSHOP</td>
<td>0-0-2-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**

This course gives the basic introduction of electronic hardware systems and provides hands-on training with familiarization, identification, testing, assembling, dismantling, fabrication and repairing such systems by making use of the various tools and instruments available in the Electronics Workshop.

**List of Exercises / Experiments (Minimum of 8 mandatory)**

1. Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.]

2. Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools, Interpret data sheets of discrete components and IC’s, Estimation and costing.

3. Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, CRO etc.] [Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de-soldering station etc.]

4. Testing of electronic components [Resistor, Capacitor, Diode, Transistor, UJT and JFET using multimeter.]

5. Inter-connection methods and soldering practice. [Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions, soldering practice in connectors and general purpose PCB, Crimping.]

6. Printed circuit boards (PCB) [Types, Single sided, Double sided, PTH, Processing methods, Design and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.]

7. Assembling of electronic circuit/system on general purpose PCB, test and show the functioning (Any Four circuits)
   1. Fixed voltage power supply with transformer, rectifier diode, capacitor filter, zener/IC regulator.
   2. LED blinking circuit using a stable multi-vibrator with transistor BC 107.
   3. Square wave generation using IC 555 timer in IC base.
   5. RC coupled amplifier with transistor BC 107.
   6. AND and NAND gates in diode transistor logic.
8. Familiarization of electronic systems (Any three systems)
1. Setting up of a PA system with different microphones, loud speakers, mixer etc.
2. Assembling and dismantling of desktop computer/laptop/mobile phones.
3. Coil/Transformer winding.
4. Identify the subsystems of TV, DTH, CCTV, Cable TV, CRO, Function generator etc.
5. Screen printing and PCB pattern transfer
6. Soldering & de-soldering of SMD using hot air soldering station.
7. Introduction to robotics- Familiarization of components (motor, sensors, battery etc.) used in robotics and assembling of simple robotic configurations.

**Expected outcome**

Student can identify the active and passive electronic components. Student gets hands-on assembling, testing, assembling, dismantling, fabrication and repairing systems by making use of the various tools and instruments available in the Electronics Workshop.
<table>
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<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>CS110</td>
<td>COMPUTER SCIENCE WORKSHOP</td>
<td>0-0-2-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**

1. To familiarize students with basic hardware and software tools
2. To implement algorithms studied in the course Introduction to Computing & Problem Solving.
3. To learn the implementation of control structures, Iterations and recursive functions, Lists, Tuples and Dictionaries.
4. To implement operations of files.
5. To implement a small micro project using Python

**List of Exercises / Experiments (Minimum of 8 mandatory)**

**List of Exercises:**

Introduction: Familiarization of hardware components of a desktop computer (motherboard, cards, memory, slots, power, cables etc.) Familiarization of Operating systems and various tools, particularly those for scientific computing, open source tools etc.

Programming exercises in Python based on the course Introduction To Computing and Problem Solving (BE 101-05). The exercises may include programs using the following concepts–

1. **Decision making, branching and looping**
   1. Variables, Expressions & Conditional statements
   2. Iteration statements (While, For etc.)
2. **Function & Function calls**
   1. Function calls, Math functions
   2. Parameters and arguments
   3. Adding new functions, Recursion
3. **Strings**
   1. String traversal
   2. String searching, Comparison
   3. Other important String methods
4. **Lists, Tuples and Dictionaries**
   1. Traversing List, List Operations
2. Creation of Dictionary and Operations
3. Lists and Tuples

5. Files and Operations
   1. Files - defining, opening/closing, operations
   2. Pickling

6. Micro Project: Students are expected to do a micro project by using Python, preferably related to the Web

Expected outcome
1. Students are able to identify common hardware components and their purpose
2. Students gain sufficient awareness about latest software tools.
3. Students are able to develop programs in Python for common problems of reasonable complexity.
<table>
<thead>
<tr>
<th>Course No:</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>CH110</td>
<td>CHEMICAL ENGINEERING WORKSHOP</td>
<td>0-0-2-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**

To impart in students the basic knowledge in chemical engineering through simple experiments and demonstrations.

**List of Exercises / Experiments (Minimum of 8 mandatory)**

1. Preparation of soap
2. Determination of flash and fire point
3. Preparation of Biodiesel
4. Specific gravity measurement
5. Fabrication of FRP laminates/ Study of filtration equipments
6. Study of distillation column
7. Study of absorption column
8. Study of heat exchanger
9. Study of size reduction equipment
10. Preparation of Pigment

**Expected outcome**

Students will have a thorough understanding of the basic concepts that they learn in the theory paper “Introduction to Chemical Engineering”.
Course No. | Course Name | L-T-P-Credits | Year of Introduction
--- | --- | --- | ---
CS100 | Computer Programming | 2-1-0 | 2016

Course Objectives

*To understand the fundamental concept of C programming and use it in problem solving.*

Syllabus

Introduction to C language; Operators and expressions; Sorting and searching; Pointers; Memory allocation; Stacks and Queues.

Course Outcomes

1. Identify appropriate C language constructs to solve problems.
2. Analyze problems, identify subtasks and implement them as functions/procedures.
3. Implement algorithms using efficient C-programming techniques.
4. Explain the concept of file system for handling data storage and apply it for solving problems.
5. Apply sorting & searching techniques to solve application programs.

References

1. Rajaraman V., Computer Basics and Programming in C, PHI.
5. Gary J. Bronson, ANSI C Programming, CENGAGE Learning India.

COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Contact Hours</th>
<th>Sem.Exam Marks; %</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to C Language: Preprocessor directives, header files, data types and qualifiers. Operators and expressions. Data input and output, control statements.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Arrays and strings- example programs. Two dimensional arrays - matrix operations. Structure, union and enumerated data type.</td>
<td>8</td>
<td>15%</td>
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<td>-----</td>
</tr>
<tr>
<td>III</td>
<td>Pointers: Array of pointers, structures and pointers. Example programs using pointers and structures.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td><strong>FIRST INTERNAL EXAM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Functions – function definition and function prototype. Function call by value and call by reference. Pointer to a function –. Recursive functions.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Sorting and Searching : Bubble sort, Selection sort, Linear Search and Binary search. Scope rules Storage classes. Bit-wise operations.</td>
<td>6</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Data files – formatted, unformatted and text files. Command line arguments – examples.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td><strong>SECOND INTERNAL EXAM</strong></td>
<td></td>
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<tr>
<td></td>
<td><strong>END SEMESTER EXAM</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course No. | Course Name | L-T-P-Credits | Year of Introduction
--- | --- | --- | ---
110 | Computer Programming Lab | | 2016

Course Objective:
- To implement algorithms studied in the course Computer Programming
- To learn the implementation of control structures, Iterations and recursive functions.
- To implement operations on different types of files.

**List of Exercises / Experiments**
(For Computer Science and Engineering Branch)

The exercises may include the Programs using the following concepts.
1. Decision making, branching and looping
   - if, if else statements
   - switch, goto statements
   - while, do, for statements
2. Arrays and strings
   - one-dimensional, two-dimensional, multidimensional arrays
   - reading/writing strings
   - operations on strings
   - string handling
3. Functions
   - user defined functions
   - function calls, arguments & return values
   - nesting of functions
   - recursive functions
   - passing arrays and strings to functions
4. Structures and unions
   - copying and comparing structure variables
   - arrays of structures
   - arrays within structures
   - structures with in structures
   - structures and functions
   - unions
5. Pointers
   - pointers and arrays
   - pointers and character strings
   - array of pointers
   - pointers and functions
   - pointers and structures
6. Files, memory allocation, bit-level programming
   - files - defining, opening/closing, input
   - output operations
   - command line arguments
   - memory allocation functions

Course Outcome
Students will be able to analyse a problem, find appropriate programming language construct should be used and implement C program for the problem.
Curriculum
for
B.Tech Degree
Semesters III to VIII
2016
Computer Science and Engineering
## BRANCH: Computer Science & Engineering

### SEMESTER - 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Credits</th>
<th>Exam Slot</th>
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<tbody>
<tr>
<td>MA201</td>
<td>Linear Algebra &amp; Complex Analysis</td>
<td>3-1-0</td>
<td>4</td>
<td>A</td>
</tr>
<tr>
<td>CS201</td>
<td>Discrete Computational Structures</td>
<td>3-1-0</td>
<td>4</td>
<td>B</td>
</tr>
<tr>
<td>CS203</td>
<td>Switching Theory and Logic Design</td>
<td>3-1-0</td>
<td>4</td>
<td>C</td>
</tr>
<tr>
<td>CS205</td>
<td>Data Structures</td>
<td>3-1-0</td>
<td>4</td>
<td>D</td>
</tr>
<tr>
<td>CS207</td>
<td>Electronics Devices &amp; Circuits</td>
<td>3-0-0</td>
<td>3</td>
<td>E</td>
</tr>
<tr>
<td>HS210/HS200</td>
<td>Life Skills/Business Economics</td>
<td>2-0-2/3-0-0</td>
<td>3</td>
<td>F</td>
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<tr>
<td>CS231</td>
<td>Data Structures Lab</td>
<td>0-0-3</td>
<td>1</td>
<td>S</td>
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<tr>
<td>CS233</td>
<td>Electronics Circuits Lab</td>
<td>0-0-3</td>
<td>1</td>
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Total Credits = 24  
Hours: 28/29  
Cumulative Credits= 71

### SEMESTER - 4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Credits</th>
<th>Exam Slot</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA202</td>
<td>Probability Distributions, Transforms and Numerical Methods</td>
<td>3-1-0</td>
<td>4</td>
<td>A</td>
</tr>
<tr>
<td>CS202</td>
<td>Computer Organization and Architecture</td>
<td>3-1-0</td>
<td>4</td>
<td>B</td>
</tr>
<tr>
<td>CS204</td>
<td>Operating Systems</td>
<td>3-1-0</td>
<td>4</td>
<td>C</td>
</tr>
<tr>
<td>CS206</td>
<td>Object Oriented Design and Programming</td>
<td>2-1-0</td>
<td>3</td>
<td>D</td>
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<tr>
<td>CS208</td>
<td>Principles of Database Design</td>
<td>2-1-0</td>
<td>3</td>
<td>E</td>
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<tr>
<td>HS210/HS200</td>
<td>Life Skills/Business Economics</td>
<td>2-0-2/3-0-0</td>
<td>3</td>
<td>F</td>
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<tr>
<td>CS232</td>
<td>Free and Open Source Software Lab</td>
<td>0-0-3</td>
<td>1</td>
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<tr>
<td>CS234</td>
<td>Digital Systems Lab</td>
<td>0-0-3</td>
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</table>

Total Credits = 23  
Hours 28/27  
Cumulative Credits= 94
**BRANCH: Computer Science & Engineering**

**SEMESTER - 5**

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>L-T-P</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CS301</td>
<td>Theory of Computation</td>
<td>3-1-0</td>
<td>4</td>
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<tr>
<td>CS303</td>
<td>System Software</td>
<td>2-1-0</td>
<td>3</td>
<td>B</td>
</tr>
<tr>
<td>CS305</td>
<td>Microprocessors and Microcontrollers</td>
<td>2-1-0</td>
<td>3</td>
<td>C</td>
</tr>
<tr>
<td>CS307</td>
<td>Data Communication</td>
<td>3-0-0</td>
<td>3</td>
<td>D</td>
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<tr>
<td>CS309</td>
<td>Graph Theory and Combinatorics</td>
<td>2-0-2</td>
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</table>

**Elective 1**

<table>
<thead>
<tr>
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<th>Course Name</th>
<th>L-T-P</th>
<th>Credits</th>
<th>Exam Slot</th>
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<tbody>
<tr>
<td>CS341</td>
<td>Design Project</td>
<td>0-1-2</td>
<td>2</td>
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<tr>
<td>CS331</td>
<td>System Software Lab</td>
<td>0-0-3</td>
<td>1</td>
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<tr>
<td>CS333</td>
<td>Application Software Development Lab</td>
<td>0-0-3</td>
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</tbody>
</table>

**Total Credits = 23**  **Hours: 29**  **Cumulative Credits= 117**

**Elective 1:-**

1. CS361  Soft Computing
2. CS363  Signals and Systems
3. CS365  Optimization Techniques
4. CS367  Logic for Computer Science
5. CS369  Digital System Testing & Testable Design
## BRANCH: Computer Science & Engineering

### SEMESTER - 6

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CS302</td>
<td>Design and Analysis of Algorithms</td>
<td>3-1-0</td>
<td>4</td>
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<tr>
<td>CS304</td>
<td>Compiler Design</td>
<td>3-0-0</td>
<td>3</td>
<td>B</td>
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<tr>
<td>CS306</td>
<td>Computer Networks</td>
<td>3-0-0</td>
<td>3</td>
<td>C</td>
</tr>
<tr>
<td>CS308</td>
<td>Software Engineering and Project Management</td>
<td>3-0-0</td>
<td>3</td>
<td>D</td>
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<tr>
<td>HS300</td>
<td>Principles of Management</td>
<td>3-0-0</td>
<td>3</td>
<td>E</td>
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<tr>
<td></td>
<td>Elective 2</td>
<td>3-0-0</td>
<td>3</td>
<td>F</td>
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<tr>
<td>CS332</td>
<td>Microprocessor Lab</td>
<td>0-0-3</td>
<td>1</td>
<td>S</td>
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<tr>
<td>CS334</td>
<td>Network Programming Lab</td>
<td>0-0-3</td>
<td>1</td>
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<tr>
<td>CS352</td>
<td>Comprehensive Exam</td>
<td>0-1-1</td>
<td>2</td>
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**Total Credits = 23**  
**Hours: 27**  
**Cumulative Credits= 140**

### Elective 2:

1. CS362 Computer Vision  
2. CS364 Mobile Computing  
3. CS366 Natural Language Processing  
4. CS368 Web Technologies  
5. CS372 High Performance Computing
## BRANCH: Computer Science & Engineering

### SEMESTER - 7

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
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<tbody>
<tr>
<td>CS401</td>
<td>Computer Graphics</td>
<td>4-0-0</td>
<td>4</td>
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<tr>
<td>CS403</td>
<td>Programming Paradigms</td>
<td>3-0-0</td>
<td>3</td>
<td>B</td>
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<tr>
<td>CS405</td>
<td>Computer System Architecture</td>
<td>3-0-0</td>
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<td>CS407</td>
<td>Distributed Computing</td>
<td>3-0-0</td>
<td>3</td>
<td>D</td>
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<tr>
<td>CS409</td>
<td>Cryptography and Network Security</td>
<td>3-0-0</td>
<td>3</td>
<td>E</td>
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<td></td>
<td><strong>Elective 3</strong></td>
<td>3-0-0</td>
<td>3</td>
<td>F</td>
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<tr>
<td>CS451</td>
<td>Seminar &amp; Project Preliminary</td>
<td>0-1-4</td>
<td>2</td>
<td>S</td>
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<tr>
<td>CS431</td>
<td>Compiler Design Lab</td>
<td>0-0-3</td>
<td>1</td>
<td>T</td>
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</tbody>
</table>

**Total Credits = 22**  
**Hours: 27**  
**Cumulative Credits= 162**

Elective 3:-

1. CS461 Computational Geometry
2. CS463 Digital Image Processing
3. CS465 Bio Informatics
4. CS467 Machine Learning
5. CS469 Computational complexity
BRANCH: **Computer Science & Engineering**

SEMESTER - 8

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Credits</th>
<th>Exam Slot</th>
</tr>
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<tbody>
<tr>
<td>CS402</td>
<td>Data Mining and Ware Housing</td>
<td>3-0-0</td>
<td>3</td>
<td>A</td>
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<tr>
<td>CS404</td>
<td>Embedded Systems</td>
<td>3-0-0</td>
<td>3</td>
<td>B</td>
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<tr>
<td>Elective 4</td>
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<td>3-0-0</td>
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<tr>
<td>Elective 5</td>
<td>(Non Departmental)</td>
<td>3-0-0</td>
<td>3</td>
<td>D</td>
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<tr>
<td>CS492</td>
<td>Project</td>
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<td>6</td>
<td>S</td>
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</tbody>
</table>

Total Credits = 18  
Hours: 30  
Cumulative Credits = 180

**Elective 4:-**
1. CS462 Fuzzy Set Theory and Applications
2. CS464 Artificial Intelligence
3. CS466 Data Science
4. CS468 Cloud Computing
5. CS472 Principles of Information Security
ELECTIVE 5 (NON DEPARTMENTAL ELECTIVE COURSES)

(Note: If a student has studied or chosen the elective course given within the brackets then the corresponding ND elective cannot be chosen)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>AU486</td>
<td>NOISE, VIBRATION AND HARSHNESS</td>
</tr>
<tr>
<td>BM482</td>
<td>BIOMEDICAL INSTRUMENTATION</td>
</tr>
<tr>
<td>BM484</td>
<td>MEDICAL IMAGING &amp; IMAGE PROCESSING TECHNIQUES</td>
</tr>
<tr>
<td>BT461</td>
<td>DESIGN OF BIOLOGICAL WASTE WATER SYSTEMS</td>
</tr>
<tr>
<td>BT362</td>
<td>SUSTAINABLE ENERGY PROCESSES</td>
</tr>
<tr>
<td>CH482</td>
<td>PROCESS UTILITIES AND PIPE LINE DESIGN</td>
</tr>
<tr>
<td>CH484</td>
<td>FUEL CELL TECHNOLOGY</td>
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<tr>
<td>CE482</td>
<td>ENVIRONMENTAL IMPACT ASSESSMENT</td>
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<tr>
<td>CE484</td>
<td>APPLIED EARTH SYSTEMS</td>
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<tr>
<td>CE486</td>
<td>GEO INFORMATICS FOR INFRASTRUCTURE MANAGEMENT</td>
</tr>
<tr>
<td>CE488</td>
<td>DISASTER MANAGEMENT</td>
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<tr>
<td>CE494</td>
<td>ENVIRONMENT HEALTH AND SAFETY</td>
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<tr>
<td>EE482</td>
<td>ENERGY MANAGEMENT AND AUDITING</td>
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<tr>
<td>EE484</td>
<td>CONTROL SYSTEMS</td>
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<tr>
<td>EE486</td>
<td>SOFT COMPUTING (CS 361 SOFT COMPUTING)</td>
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<tr>
<td>EE488</td>
<td>INDUSTRIAL AUTOMATION</td>
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<tr>
<td>EE494</td>
<td>INSTRUMENTATION SYSTEMS</td>
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<tr>
<td>EC482</td>
<td>BIOMEDICAL ENGINEERING</td>
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<tr>
<td>FT482</td>
<td>FOOD PROCESS ENGINEERING</td>
</tr>
<tr>
<td>FT484</td>
<td>FOOD STORAGE ENGINEERING</td>
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</table>
24. FT486 FOOD ADDITIVES AND FLAVOURING
25. IE482 FINANCIAL MANAGEMENT
26. IE484 INTRODUCTION TO BUSINESS ANALYTICS
27. IE486 DESIGN AND ANALYSIS OF EXPERIMENTS
28. IE488 TOTAL QUALITY MANAGEMENT
29. IC482 BIOMEDICAL SIGNAL PROCESSING
30. IT482 INFORMATION STORAGE MANAGEMENT
31. MA482 APPLIED LINEAR ALGEBRA
32. MA484 OPERATIONS RESEARCH (CS 365 OPTIMISATION TECHNIQUES)
33. MA486 ADVANCED NUMERICAL COMPUTATIONS
34. ME484 FINITE ELEMENT ANALYSIS
35. ME482 ENERGY CONSERVATION AND MANAGEMENT
36. ME471 OPTIMIZATION TECHNIQUES (CS 365 OPTIMISATION TECHNIQUES)
37. MP482 PRODUCT DEVELOPMENT AND DESIGN
38. MP469 INDUSTRIAL PSYCHOLOGY & ORGANIZATIONAL BEHAVIOUR
39. MT482 INDUSTRIAL SAFETY
40. MR482 MECHATRONICS
41. FS482 RESPONSIBLE ENGINEERING
42. SB482 DREDGERS AND HARBOUR CRAFTS
43. HS482 PROFESSIONAL ETHICS
Course No. | Course Name | L-T-P - Credits | Year of Introduction
--- | --- | --- | ---
MA201 | LINEAR ALGEBRA AND COMPLEX ANALYSIS | 3-1-0-4 | 2016

Prerequisite: Nil

Course Objectives

COURSE OBJECTIVES
- To equip the students with methods of solving a general system of linear equations.
- To familiarize them with the concept of Eigen values and diagonalization of a matrix which have many applications in Engineering.
- To understand the basic theory of functions of a complex variable and conformal Transformations.

Syllabus

Analyticity of complex functions - Complex differentiation - Conformal mappings - Complex integration - System of linear equations - Eigen value problem

Expected outcome.

At the end of the course students will be able to
(i) solve any given system of linear equations
(ii) find the Eigen values of a matrix and how to diagonalize a matrix
(iii) identify analytic functions and Harmonic functions.
(iv) evaluate real definite Integrals as application of Residue Theorem
(v) identify conformal mappings(vi) find regions that are mapped under certain Transformations

Text Book:

References:
1. Dennis g Zill & Patric D Shanahan- A first Course in Complex Analysis with Applications-Jones&Bartlet Publishers
3. Lipschutz, Linear Algebra, 3e (Schaums Series) McGraw Hill Education India 2005

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>Complex differentiation: Text 1[13.3,13.4] Limit, continuity and derivative of complex functions</td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td>Analytic Functions</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cauchy–Riemann Equation(Proof of sufficient condition of analyticity &amp; C R Equations in polar form not required)-Laplace’s Equation</td>
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<tr>
<td></td>
<td>Harmonic functions, Harmonic Conjugate</td>
<td>2</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Conformal mapping: Text 1[17.1-17.4] Geometry of Analytic functions Conformal Mapping,</td>
<td>1</td>
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<tr>
<td></td>
<td>Mapping $w = z^2$ conformity of $w = e^z$.</td>
<td>2</td>
<td>15%</td>
</tr>
</tbody>
</table>
The mapping $w = z + \frac{1}{z}$

Properties of $w = \frac{1}{z}$

- Circles and straight lines, extended complex plane, fixed points
- Special linear fractional Transformations, Cross Ratio, Cross Ratio property-Mapping of disks and half planes
- Conformal mapping by $w = \sin z$ & $w = \cos z$

(Assignment: Application of analytic functions in Engineering)

**FIRST INTERNAL EXAMINATION**

<table>
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<tr>
<th>Complexity</th>
<th>Description</th>
<th>Weight</th>
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<tr>
<td>III</td>
<td>Complex Integration. Text 1 [14.1-14.4] [15.4 &amp; 16.1] \nDefinition Complex Line Integrals, First Evaluation Method, Second Evaluation Method \nCauchy’s Integral Theorem (without proof), Independence of path (without proof), Cauchy’s Integral Theorem for Multiply Connected Domains (without proof) \nCauchy’s Integral Formula- Derivatives of Analytic Functions (without proof) \nApplication of derivative of Analytical Functions \nTaylor and Maclaurin series (without proof), Power series as Taylor series, Practical methods (without proof) \nLaurent’s series (without proof)</td>
<td>2</td>
</tr>
<tr>
<td>IV</td>
<td>Residue Integration Text 1 [16.2-16.4] \nSingularities, Zeros, Poles, Essential singularity, Zeros of analytic functions \nResidue Integration Method, Formulas for Residues, Several singularities inside the contour Residue Theorem \nEvaluation of Real Integrals (i) Integrals of rational functions of $\sin \theta$ and $\cos \theta$ (ii) Integrals of the type $\int_0^\infty f(x)dx$ (Type I, Integrals from 0 to $\infty$) \n(Assignment: Application of Complex integration in Engineering)</td>
<td>2</td>
</tr>
<tr>
<td>V</td>
<td>Linear system of Equations Text 1 [7.3-7.5] \nLinear systems of Equations, Coefficient Matrix, Augmented Matrix \nGauss Elimination and back substitution, Elementary row operations, Row equivalent systems, Gauss elimination-Three possible cases, Row Echelon form and Information from it.</td>
<td>1</td>
</tr>
<tr>
<td>VI</td>
<td>Linear independence-rank of a matrix</td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>-------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vector Space-Dimension-basis-vector space $\mathbb{R}^3$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Solution of linear systems, Fundamental theorem of non-homogeneous linear systems (Without proof)-Homogeneous linear systems (Theory only)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VI</th>
<th>Matrix Eigen value Problem Text 1.(8.1,8.3 &amp;8.4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Determination of Eigen values and Eigen vectors-Eigen space</td>
</tr>
<tr>
<td></td>
<td>Symmetric, Skew Symmetric and Orthogonal matrices –simple properties (without proof)</td>
</tr>
<tr>
<td></td>
<td>Basis of Eigen vectors-Similar matrices Diagonalization of a matrix-Quadratic forms- Principal axis theorem(without proof)</td>
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<td>(Assignment-Some applications of Eigen values(8.2))</td>
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**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3 hours  
The question paper will consist of 3 parts.  
Part A will have 3 questions of 15 marks each uniformly covering modules I and II. Each question may have two sub questions.

Part B will have 3 questions of 15 marks each uniformly covering modules III and IV. Each question may have two sub questions.

Part C will have 3 questions of 20 marks each uniformly covering modules V and VI. Each question may have three sub questions.

Any two questions from each part have to be answered.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS201</td>
<td>DISCRETE COMPUTATIONAL STRUCTURES</td>
<td>3-1-0-4</td>
<td>2016</td>
</tr>
</tbody>
</table>

Pre-requisite: NIL

Course Objectives
1. To introduce mathematical notations and concepts in discrete mathematics that is essential for computing.
2. To train on mathematical reasoning and proof strategies.
3. To cultivate analytical thinking and creative problem solving skills.

Syllabus
Review of Set theory, Countable and uncountable Sets, Review of Permutations and combinations, Pigeon Hole Principle, Recurrence Relations and Solutions, Algebraic systems (semigroups, monoids, groups, rings, fields), Posets and Lattices, Prepositional and Predicate Calculus, Proof Techniques.

Expected Outcome:
- Students will be able to
  1. identify and apply operations on discrete structures such as sets, relations and functions in different areas of computing.
  2. verify the validity of an argument using propositional and predicate logic.
  3. construct proofs using direct proof, proof by contraposition, proof by contradiction and proof by cases, and by mathematical induction.
  4. solve problems using algebraic structures.
  5. solve problems using counting techniques and combinatorics.
  6. apply recurrence relations to solve problems in different domains.

Text Books

References:
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours (54)</th>
<th>End Sem Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Review of elementary set theory: Algebra of sets – Ordered pairs and Cartesian products – Countable and Uncountable sets</td>
<td>3</td>
<td>15 %</td>
</tr>
<tr>
<td></td>
<td>Relations: Relations on sets – Types of relations and their properties – Relational matrix and the graph of a relation – Partitions – Equivalence relations - Partial ordering- Posets – Hasse diagrams - Meet and Join – Infimum and Supremum</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Functions: Injective, Surjective and Bijective functions - Inverse of a function- Composition</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Review of Permutations and combinations, Principle of inclusion exclusion, Pigeon Hole Principle, Recurrence Relations: Introduction- Linear recurrence relations with constant coefficients– Homogeneous solutions – Particular solutions – Total solutions Algebraic systems:- Semigroups and monoids - Homomorphism, Subsemigroups and submonoids</td>
<td>3</td>
<td>15 %</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAM**

| III    | Algebraic systems (contd…):- Groups, definition and elementary properties, subgroups, Homomorphism and Isomorphism, Generators - Cyclic Groups, Cosets and Lagrange’s Theorem Algebraic systems with two binary operations- rings, fields-sub rings, ring homomorphism | 6 | 15 % |


**SECOND INTERNAL EXAM**

<p>| V      | Propositional Logic:- Propositions – Logical connectives – Truth tables | 2 | 20 % |
|        | Tautologies and contradictions – Contra positive – Logical | 3 | |</p>
<table>
<thead>
<tr>
<th>VI</th>
<th>equivalences and implications</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicate Logic:</td>
<td>Validity of arguments.</td>
<td>3</td>
</tr>
<tr>
<td>Proof techniques:</td>
<td>Theory of inference: Validity of arguments.</td>
<td>3</td>
</tr>
<tr>
<td>Mathematical induction and its variants – Proof by Contradiction – Proof by Counter Example – Proof by Contra positive.</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

END SEMESTER EXAM

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module I and II; Two questions have to be answered. Each question can have a maximum of three subparts
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module III and IV; Two questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.
Course No. | Course Name                        | L-T-P-Credits | Year of Introduction |
-----------|-----------------------------------|---------------|----------------------|
CS203      | Switching Theory and Logic Design | 3-1-0-4       | 2016                 |

Pre-requisite: Nil

Course Objectives
1. To impart an understanding of the basic concepts of Boolean algebra and digital systems.
2. To impart familiarity with the design and implementation of different types of practically used sequential circuits.
3. To provide an introduction to use Hardware Description Language

Syllabus

Expected Outcome:
Students will be able to:-
1. apply the basic concepts of Boolean algebra for the simplification and implementation of logic functions using suitable gates namely NAND, NOR etc.
2. design simple Combinational Circuits such as Adders, Subtractors, Code Convertors, Decoders, Multiplexers, Magnitude Comparators etc.
3. design Sequential Circuits such as different types of Counters, Shift Registers, Serial Adders, Sequence Generators.
4. use Hardware Description Language for describing simple logic circuits.
5. apply algorithms for addition/subtraction operations on Binary, BCD and Floating Point Numbers.

Text Books:
1. Mano M. M., Digital Logic & Computer Design, 4/e, Pearson Education, 2013. [Chapters: 1, 2, 3, 4, 5, 6, 7].
3. M. Morris Mano, Computer System Architecture, 3/e, Pearson Education, 2007. [Chapter 10.1, 10.2, 10.5, 10.6, 10.7].
4. Harris D. M. and, S. L. Harris, Digital Design and Computer Architecture, 2/e, Morgan Kaufmann Publishers, 2013 [Chapter 4.1, 4.2]

References:

COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Contact Hours (52)</th>
<th>Sem. Exam Marks; %</th>
</tr>
</thead>
</table>


| I | Number systems – Decimal, Binary, Octal and Hexadecimal – conversion from one system to another – representation of negative numbers – representation of BCD numbers – character representation – character coding schemes – ASCII – EBCDIC etc.  
Addition, subtraction, multiplication and division of binary numbers (no algorithms). Addition and subtraction of BCD, Octal and Hexadecimal numbers.  
Representation of floating point numbers – precision – addition, subtraction, multiplication and division of floating point numbers | 10 | 15% |
| II | Introduction — Postulates of Boolean algebra – Canonical and Standard Forms — logic functions and gates  
methods of minimization of logic functions — Karnaugh map method and QuinMcCusky method  
Product-of-Sums Simplification — Don’t-Care Conditions. | 09 | 15% |
| III | Combinational Logic: combinational Circuits and design Procedure — binary adder and subtractor — multi—level NAND and NOR circuits — Exclusive-OR and Equivalence Functions.  
Implementation of combination logic: parallel adder, carry look ahead adder, BCD adder, code converter, magnitude comparator, decoder, multiplexer, de-multiplexer, parity generator | 10 | 15% |
Clocked sequential circuits: state diagram — state reduction and assignment — design with state equations | 08 | 15% |
Counters: asynchronous counters — binary and BCD ripple counters — timing sequences — synchronous counters — up-down counter, BCD counter, Johnson counter — timing sequences and state diagrams | 08 | 20% |
<table>
<thead>
<tr>
<th>VI</th>
<th>Memory and Programmable Logic: Random-Access Memory (RAM)—Memory Decoding—Error Detection and Correction — Read only Memory (ROM), Programmable Logic Array (PLA).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HDL: fundamentals, combinational logic, adder, multiplexer.</td>
</tr>
<tr>
<td></td>
<td>Arithmetic algorithms: Algorithms for addition and subtraction of binary and BCD numbers, algorithms for floating point addition and subtraction.</td>
</tr>
</tbody>
</table>

**Question Paper Pattern:**

1. There will be five parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having 9 marks, uniformly covering module I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having 9 marks, uniformly covering module III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/design/numerical questions.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS205</td>
<td>Data Structures</td>
<td>3-1-0-4</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Pre-requisite:** B101-05 Introduction to Computing and Problem Solving

**Course Objectives**

1. To impart a thorough understanding of linear data structures such as stacks, queues and their applications.
2. To impart a thorough understanding of non-linear data structures such as trees, graphs and their applications.
3. To impart familiarity with various sorting, searching and hashing techniques and their performance comparison.
4. To impart a basic understanding of memory management.

**Syllabus**

Introduction to various programming methodologies, terminologies and basics of algorithms analysis, Basic Abstract and Concrete Linear Data Structures, Non-linear Data Structures, Memory Management, Sorting Algorithms, Searching Algorithms, Hashing.

**Expected Outcome:**

Students will be able to

1. compare different programming methodologies and define asymptotic notations to analyze performance of algorithms.
2. use appropriate data structures like arrays, linked list, stacks and queues to solve real world problems efficiently.
3. represent and manipulate data using nonlinear data structures like trees and graphs to design algorithms for various applications.
4. illustrate and compare various techniques for searching and sorting.
5. appreciate different memory management techniques and their significance.
6. illustrate various hashing techniques.

**Text Books:**


**References**

## COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to programming methodologies – structured approach, stepwise refinement techniques, programming style, documentation – analysis of algorithms: frequency count, definition of Big O notation, asymptotic analysis of simple algorithms. Recursive and iterative algorithms.</td>
<td>9</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Abstract and Concrete Data Structures- Basic data structures – vectors and arrays. Applications, Linked lists:- singly linked list, doubly linked list, Circular linked list, operations on linked list, linked list with header nodes, applications of linked list: polynomials,.</td>
<td>9</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Applications of linked list (continued): Memory management, memory allocation and de-allocation. First-fit, best-fit and worst-fit allocation schemes. Implementation of Stacks and Queues using arrays and linked list, DEQUEUE (double ended queue). Multiple Stacks and Queues, Applications.</td>
<td>9</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>String: - representation of strings, concatenation, substring searching and deletion. Trees: - m-ary Tree, Binary Trees – level and height of the tree, complete-binary tree representation using array, tree traversals (Recursive and non-recursive), applications. Binary search tree – creation, insertion and deletion and search operations, applications.</td>
<td>10</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Graphs – representation of graphs, BFS and DFS (analysis not required) applications. Sorting techniques – Bubble sort, Selection Sort, Insertion sort, Merge sort, Quick sort, Heaps and Heap sort. Searching algorithms (Performance comparison expected. Detailed analysis not required)</td>
<td>09</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Linear and Binary search. (Performance comparison expected. Detailed analysis not required) Hash Tables – Hashing functions – Mid square, division, folding, digit analysis, collusion resolution and Overflow handling techniques.</td>
<td>10</td>
<td>20%</td>
</tr>
</tbody>
</table>
Question Paper Pattern:

1. There will be five parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering module I and II; All four questions have to be answered.
3. Part B
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering module I and II; Two questions have to be answered. Each question can have a maximum of three subparts
4. Part C
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering module III and IV; All four questions have to be answered.
5. Part D
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering module III and IV; Two questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical/design questions.
Course code | Course Name | L-T-P Credits | Year of Introduction  
--- | --- | --- | ---  
CS207 | ELECTRONIC DEVICES & CIRCUITS | 3-0-0-3 | 2016  

**Pre-requisite:** BE101-04 Introduction to Electronics Engg.

**Course Objectives:**
1. To introduce to the students the fundamental concepts of electronic devices and circuits for engineering applications.
2. To develop the skill of analysis and design of various analog circuits using electronic devices.
3. To provide comprehensive idea about working principle, operation and applications of electronic circuits.
4. To equip the students with a sound understanding of fundamental concepts of operational amplifiers.
5. To expose to the diversity of operations that operational amplifiers can perform in a wide range of applications.
6. To expose to a variety of electronic circuits/systems using various analog ICs.

**Syllabus**
RC Circuits, Diode Circuits, Regulated power supplies, **Field effect transistor**, DC analysis of BJT, RC Coupled amplifier, MOSFET amplifiers, Feedback amplifiers, Power amplifiers, Oscillators, Multivibrators, Operational Amplifier and its applications, Timer IC.

**Expected Outcome:**
Students will be able to
1. explain, illustrate, and design the different electronic circuits using electronic components.
2. design circuits using operational amplifiers for various applications.

**Text Books:**

**References :**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours (40)</th>
<th>Sem Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wave shaping circuits: Sinusoidal and non-sinusoidal wave shapes, Principle and working of RC differentiating and integrating circuits, Conversion of one non-sinusoidal wave shape into another. Clipping circuits - Positive, negative and biased clipper.</td>
<td>5</td>
<td>15%</td>
</tr>
<tr>
<td>2</td>
<td><strong>Regulated power supplies</strong>: Review of simple zener voltage regulator, Shunt and series voltage regulator using transistors, Current limiting and fold back protection, 3 pin regulators-78XX and 79XX, IC 723 and its use as low and high voltage regulators, DC to DC conversion. Circuit/block diagram and working of SMPS.</td>
<td>4</td>
<td>15 %</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td><strong>Field effect transistors</strong>: JFET – Structure, principle of operation and characteristics, Comparison with BJT. MOSFET- Structure, Enhancement and Depletion types, principle of operation and characteristics.</td>
<td>3</td>
<td>15 %</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAM**

| 3 | **Amplifiers**: Introduction to transistor biasing, operating point, concept of load line, thermal stability, fixed bias, self bias, voltage divider bias. Classification of amplifiers, RC coupled amplifier - voltage gain and frequency response. Multistage amplifiers - effect of cascading on gain and bandwidth. Feedback in amplifiers - Effect of negative feedback on amplifiers. MOSFET Amplifier- Circuit diagram and working of common source MOSFET amplifier. | 7 | 15 % |
| 4 | **Oscillators**: Classification, criterion for oscillation, analysis of Wien bridge oscillator, Hartley and Crystal oscillator. Non-sinusoidal oscillators: Astable, monostable and bi-stable multivibrators using transistors (Only design equations and working of circuit are required, Analysis not required). | 5 | 15 % |

**SECOND INTERNAL EXAM**

| 5 | **Operational amplifiers**: Differential amplifier, characteristics of op-amps(gain, bandwidth, slew rate, CMRR, offset voltage, offset current), comparison of ideal and practical op-amp(IC741), applications of op-amps- scale changer, sign changer, adder/summing amplifier, subtractor, integrator, differentiator, Schmitt trigger, Wien bridge oscillator. | 8 | 20 % |
| 6 | **Integrated circuits:** Active filters – Low pass and high pass (first and second order) active filters using op-amp with gain (No analysis required).  
     D/A and A/D convertors – important specifications, Sample and hold circuit.  
     Binary weighted resistor and R-2R ladder type D/A convertors. (concepts only).  
     Flash, dual slope and successive approximation type A/D convertors.  
     Circuit diagram and working of Timer IC555, astable and monostablemultivibrators using 555. | 8 | 20 % |

**END SEMESTER EXAM**

**Question Paper Pattern:**

1. There will be five parts in the question paper – A, B, C, D, E
2. Part A  
   a. Total marks : 12  
   b. *Four* questions each having 3 marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B  
   a. Total marks : 18  
   b. *Three* questions each having 9 marks, uniformly covering module I and II; Two questions have to be answered. Each question can have a maximum of three subparts
4. Part C  
   a. Total marks : 12  
   b. *Four* questions each having 3 marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D  
   a. Total marks : 18  
   b. *Three* questions each having 9 marks, uniformly covering module III and IV; Two questions have to be answered. Each question can have a maximum of three subparts
6. Part E  
   a. Total Marks: 40  
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.  
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS200</td>
<td>Business Economics</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite: Nil**

**Course Objectives**

- To familiarize the prospective engineers with elementary Principles of Economics and Business Economics.
- To acquaint the students with tools and techniques that are useful in their profession in Business Decision Making which will enhance their employability;
- To apply business analysis to the “firm” under different market conditions;
- To apply economic models to examine current economic scenario and evaluate policy options for addressing economic issues
- To gain understanding of some Macroeconomic concepts to improve their ability to understand the business climate;
- To prepare and analyse various business tools like balance sheet, cost benefit analysis and rate of returns at an elementary level

**Syllabus**

Business Economics - basic concepts, tools and analysis, scarcity and choices, resource allocation, marginal analysis, opportunity costs and production possibility curve. Fundamentals of microeconomics - Demand and Supply Analysis, equilibrium, elasticity, production and production function, cost analysis, break-even analysis and markets. Basics of macroeconomics - the circular flow models, national income analysis, inflation, trade cycles, money and credit, and monetary policy. Business decisions - investment analysis, Capital Budgeting decisions, forecasting techniques and elementary Balance Sheet and taxation, business financing, international investments

**Expected outcome**

A student who has undergone this course would be able to

i. make investment decisions based on capital budgeting methods in alignment with microeconomic and macroeconomic theories.
ii. able to analyse the profitability of the firm, economy of operation, determination of price under various market situations with good grasp on the effect of trade cycles in business.
iii. gain knowledge on Monetary theory, measures by RBI in controlling interest rate and emerging concepts like Bit Coin.
iv. gain knowledge of elementary accounting concepts used for preparing balance sheet and interpretation of balance sheet

**Text Books**

References:

### Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Business Economics</strong> and its role in managerial decision making- meaning-scope-relevance-economic problems-scarcity Vs choice (2 Hrs)-Basic concepts in economics-scarcity, choice, resource allocation- Trade-off-opportunity cost-marginal analysis- marginal utility theory, Law of diminishing marginal utility -production possibility curve (2 Hrs)</td>
<td>4</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Basics of Micro Economics I</strong> Demand and Supply analysis-equilibrium-elasticity (demand and supply) (3 Hrs.) -Production concepts-average product-marginal product-law of variable proportions- Production function-Cobb Douglas function-problems (3 Hrs.)</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td><strong>Basics of Micro Economics II</strong> Concept of costs-marginal, average, fixed, variable costs-cost curves-shut down point-long run and short run (3 Hrs.)- Break Even Analysis-Problem-Markets-Perfect Competition, Monopoly and Monopolistic Competition, Oligopoly- Cartel and collusion (3 Hrs.).</td>
<td>6</td>
<td>15%</td>
</tr>
</tbody>
</table>
## SECOND INTERNAL EXAMINATION

| V | **Business Decisions I** - Investment analysis - Capital Budgeting - NPV, IRR, Profitability Index, ARR, Payback Period (5 Hrs.) - Business decisions under certainty-uncertainty-selection of alternatives-risk and sensitivity-cost benefit analysis-resource management (4 Hrs.) | 9 | 20% |
| VI | **Business Decisions II** - Balance sheet preparation-principles and interpretation-forecasting techniques (7 Hrs.)-business financing-sources of capital- Capital and money markets-international financing-FDI, FPI, FII-Basic Principles of taxation-direct tax, indirect tax-GST (2 hrs.) | 9 | 20% |

## END SEMESTER EXAM

**Question Paper Pattern**

Max. marks: 100, Time: 3 hours

The question paper shall consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note:** In all parts, each question can have a maximum of four sub questions, if needed.
Course No. | Course Name | L-T-P - Credits | Year of Introduction
---|---|---|---
CS231 | DATA STRUCTURES LAB | 0-0-3-1 | 2016

_Pre-requisite:_ CS205 Data structures

**Course Objectives**

1. To implement basic linear and non-linear data structures and their major operations.
2. To implement applications using these data structures.
3. To implement algorithms for various sorting techniques.

**List of Exercises/Experiments :** (Minimum 12 are to be done)

1. Implementation of Stack and Multiple stacks using one dimensional array. **
2. Application problems using stacks: Infix to post fix conversion, post-fix and pre-fix evaluation, MAZE problem etc. **
4. Implementation of various linked list operations. **
5. Implementation of stack, queue and their applications using linked list.
6. Implementation of trees using linked list
7. Representation of polynomials using linked list, addition and multiplication of polynomials. **
8. Implementation of binary trees using linked lists and arrays- creations, insertion, deletion and traversal. **
9. Implementation of binary search trees – creation, insertion, deletion, search
10. Application using trees
11. Implementation of sorting algorithms – bubble, insertion, selection, quick (recursive and non-recursive), merge sort (recursive and non-recursive), and heap sort. **
12. Implementation of searching algorithms – linear search, binary search. **
13. Representation of graphs and computing various parameters (in degree, out degree etc.) - adjacency list, adjacency matrix.
15. Implementation of hash table using various mapping functions, various collision and overflow resolving schemes. **
16. Implementation of various string operations.
17. Simulation of first-fit, best-fit and worst-fit allocations.

18. Simulation of a basic memory allocator and garbage collector using doubly linked list.

**mandatory.**

<table>
<thead>
<tr>
<th>Expected Outcome:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will be able to:</td>
</tr>
</tbody>
</table>

1. appreciate the importance of structure and abstract data type, and their basic usability in different applications.
2. analyze and differentiate different algorithms based on their time complexity.
3. implement linear and non-linear data structures using linked lists.
4. understand and apply various data structure such as stacks, queues, trees, graphs, etc. to solve various computing problems.
5. implement various kinds of searching and sorting techniques, and decide when to choose which technique.
6. identify and use a suitable data structure and algorithm to solve a real world problem.
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS233</td>
<td>ELECTRONICS CIRCUITS LAB</td>
<td>0-0-3-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Pre-requisite:** CS207 Electronic devices & circuits

**Course Objectives:**
1. To introduce the working of analog electronic circuits.
2. To design, implement and demonstrate analog circuits using electronic components.
3. To provide hands-on experience to the students so that they are able to put theoretical concepts to practice.
4. To use computer simulation tools such as PSPICE, or Multisim to the simulation of electronic circuits.
5. To create an ability to develop descriptions, explanations, predictions and models using evidence.
6. To create an ability to communicate effectively the scientific procedures and explanations about the experiments in oral/report forms.

**List of Exercises/Experiments :**
(Minimum 13 experiments are to be done in the semester, at least 6 each should be selected from the first(Exp. 1-10) and second(Exp. 11-20) half. Experiment no. 18 is compulsory).

1. Forward and reverse characteristics of PN diode and Zener diode
2. Input and output characteristics of BJT in CE configuration and evaluation of parameters
3. RC integrating and differentiating circuits-Transient response with different time constant
4. RC low pass and high pass circuits- Frequency response with sinusoidal input
5. Clipping circuits (Positive, negative and biased) - Transient and transfer characteristics
6. Clamping circuits (Positive, negative and biased)- Transient characteristics
7. Bridge Rectifier - with and without filter- ripple factor and regulation
8. Simple Zener regulator- Line and load characteristics
9. RC coupled CE amplifier – Mid band gain and frequency response
10. RC phase shift or Wien bridge oscillator using transistor
11. Astable and Monostable multivibrators using transistors
12. Series voltage regulator (Two transistors)- Line and load characteristics
13. Voltage regulator using LM 723)- Line and load characteristics
14. Astable and mono stable multivibrators using 555 Timer
15. Inverting and non-inverting amplifier using op-amp IC741
16. Instrumentation amplifier using op-amp IC741
17. RC phase shift or Wien bridge oscillator using op-amp IC741
18. Simulation of simple circuits (at least 6 from above) using any SPICE software(Transient, AC and DC analysis)
**Expected Outcome:**

Students will be able to:

1. identify basic electronic components, design and develop electronic circuits.
2. Design and demonstrate functioning of various discrete analog circuits.
3. Be familiar with computer simulation of electronic circuits and how to use it proficiently for design and development of electronic circuits.
4. Understand the concepts and their applications in engineering.
5. Communicate effectively the scientific procedures and explanations in formal technical presentations/reports.
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA202</td>
<td>Probability distributions, Transforms and Numerical Methods</td>
<td>3-1-0-4</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**

- To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in various Engineering and social life situations.
- To know Laplace and Fourier transforms which has wide application in all Engineering courses.
- To enable the students to solve various engineering problems using numerical methods.

**Syllabus**

Discrete random variables and Discrete Probability Distribution.
Continuous Random variables and Continuous Probability Distribution.
Fourier transforms.
Laplace Transforms.
Numerical methods-solution of Algebraic and transcendental Equations, Interpolation.

**Expected outcome**

After the completion of the course student is expected to have concept of
(i) Discrete and continuous probability density functions and special probability distributions.
(ii) Laplace and Fourier transforms and apply them in their Engineering branch
(iii) numerical methods and their applications in solving Engineering problems.

**Text Books:**


**References:**


**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
</table>
| I      | **Discrete Probability Distributions.** (Relevant topics in section 4.1,4.2,4.4,4.6 Text1 )
Discrete Random Variables, Probability distribution function,
Cumulative distribution function.
Mean and Variance of Discrete Probability Distribution.
Binomial Distribution-Mean and variance.
Poisson Approximation to the Binomial Distribution. Poisson distribution-Mean and variance. | 2     | 15%             |
| II | **Continuous Probability Distributions.** *(Relevant topics in section 5.1, 5.2, 5.5, 5.7 Text1)*  
Continuous Random Variable, Probability density function,  
Cumulative density function, Mean and variance.  
Normal Distribution, Mean and variance (without proof).  
Uniform Distribution. Mean and variance.  
Exponential Distribution, Mean and variance. | 2 | 15% |
| --- | --- | --- | --- |
| III | **Fourier Integrals and transforms.** *(Relevant topics in section 11.7, 11.8, 11.9 Text2)*  
Fourier Integrals. Fourier integral theorem (without proof).  
Fourier Transform and inverse transform.  
Fourier Sine & Cosine Transform, inverse transform. | 3 | 15% |
| IV | **Laplace transforms.** *(Relevant topics in section 6.1, 6.2, 6.3, 6.5, 6.6 Text2)*  
Laplace Transforms, linearity, first shifting Theorem.  
Transform of derivative and Integral, Inverse Laplace transform, Solution of ordinary differential equation using Laplace transform.  
Unit step function, second shifting theorem.  
Convolution Theorem (without proof).  
Differentiation and Integration of transforms. | 4 | 15% |
| V | **Numerical Techniques.** *(Relevant topics in section 19.1, 19.2, 19.3 Text2)*  
Solution Of equations by Iteration, Newton- Raphson Method.  
Interpolation of Unequal intervals-Lagrange’s Interpolation formula.  
Interpolation of Equal intervals-Newton’s forward difference formula, Newton’s Backward difference formula. | 2 | 20% |
| VI | **Numerical Techniques.** *(Relevant topics in section 19.5, 20.1, 20.3, 21.1 Text2)*  
Solution to linear System- Gauss Elimination, Gauss Seidal Iteration Method.  
Numeric Integration-Trapezoidal Rule, Simpson’s 1/3 Rule.  
Numerical solution of firstorder ODE-Euler method, Runge-Kutta Method (fourth order). | 3 | 20% |
QUESTION PAPER PATTERN:

Maximum Marks : 100      Exam Duration: 3 hours

The question paper will consist of 3 parts.
Part A will have 3 questions of 15 marks each uniformly covering modules I and II. Each question may have two sub questions.

Part B will have 3 questions of 15 marks each uniformly covering modules III and IV. Each question may have two sub questions.

Part C will have 3 questions of 20 marks each uniformly covering modules V and VI. Each question may have three sub questions.

Any two questions from each part have to be answered.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P -Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS202</td>
<td>Computer Organization and Architecture</td>
<td>3-1-0-4</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Pre-requisite:** CS203 Switching theory and logic design

**Course Objectives**
1. To impart an understanding of the internal organization and operations of a computer.
2. To introduce the concepts of processor logic design and control logic design.

**Syllabus**
Fundamental building blocks and functional units of a computer. Execution phases of an instruction. Arithmetic Algorithms. Design of the processing unit – how arithmetic and logic operations are performed. Design of the control unit – hardwired and microprogrammed control. I/O organisation – interrupts, DMA, different interface standards. Memory Subsystem – different types.

**Expected outcome**
Students will be able to:
1. identify the basic structure and functional units of a digital computer.
2. analyze the effect of addressing modes on the execution time of a program.
3. design processing unit using the concepts of ALU and control logic design.
4. identify the pros and cons of different types of control logic design in processors.
5. select appropriate interfacing standards for I/O devices.
6. identify the roles of various functional units of a computer in instruction execution.

**Text Books:**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem.ExamMarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Basic Structure of computers</strong> functional units – basic operational concepts – bus structures – software. Memory locations and addresses – memory operations – instructions and instruction sequencing – addressing modes – ARM Example (programs not required). Basic I/O operations – stacks subroutine calls.</td>
<td>6</td>
<td>15%</td>
</tr>
</tbody>
</table>
| II | **Basic processing unit** – fundamental concepts – instruction cycle - execution of a complete instruction – multiple- bus organization – sequencing of control signals.  
Arithmetic algorithms: Algorithms for multiplication and division of binary and BCD numbers — array multiplier — Booth’s multiplication algorithm — restoring and non-restoring division — algorithms for floating point, multiplication and division. |
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</table>

**FIRST INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>III</th>
<th><strong>I/O organization:</strong> accessing of I/O devices – interrupts – direct memory access – buses – interface circuits – standard I/O interfaces (PCI, SCSI, USB)</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>IV</th>
<th><strong>Memory system:</strong> basic concepts – semiconductor RAMs – memory system considerations – semiconductor ROMs – flash memory – cache memory and mapping functions.</th>
</tr>
</thead>
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</table>

**SECOND INTERNAL EXAMINATION**

| V | **Processor Logic Design:** Register transfer logic – inter register transfer – arithmetic, logic and shift micro operations – conditional control statements.  
**Processor organization:** – design of arithmetic unit, logic unit, arithmetic logic unit and shifter – status register – processor unit – design of accumulator. |
<table>
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</table>

| VI | **Control Logic Design:** Control organization – design of hardwired control – control of processor unit – PLA control.  
**Micro-programmed control:** Microinstructions – horizontal and vertical micro instructions – micro-program sequencer – micro programmed CPU organization. |
<table>
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</tbody>
</table>

**END SEMESTER EXAM**
Question Paper Pattern:

1. There will be five parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering module I and II; All four questions have to be answered.
3. Part B
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering module I and II; Two questions have to be answered. Each question can have a maximum of three subparts
4. Part C
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering module III and IV; All four questions have to be answered.
5. Part D
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering module III and IV; Two questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions..
Course code | Course Name | L-T-P -Credits | Year of Introduction
--- | --- | --- | ---
CS204 | Operating Systems | 3-1-0-4 | 2016

Pre-requisite: CS205 Data structures

Course Objectives
1. To impart fundamental understanding of the purpose, structure, functions of operating system.
2. To impart the key design issues of an operating system

Syllabus
Basic concepts of Operating System, its structure, Process management, inter-process communication, process synchronization, CPU Scheduling, deadlocks, Memory Management, swapping, segmentation, paging, Storage Management - disk scheduling, RAID, File System Interface-implementation. Protection.

Expected outcome
Students will be able to:
1. identify the significance of operating system in computing devices.
2. exemplify the communication between application programs and hardware devices through system calls.
3. compare and illustrate various process scheduling algorithms.
4. apply appropriate memory and file management schemes.
5. illustrate various disk scheduling algorithms.
6. appreciate the need of access control and protection in an operating system.

Text Book:

References:

Course Plan
Module | Contents | Hours (52) | Sem. Exam marks
--- | --- | --- | ---
<table>
<thead>
<tr>
<th>Section</th>
<th>Topic</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td><strong>Process Synchronization:</strong> Critical Section – Peterson's solution. Synchronization – Locks, Semaphores, Monitors, Classical Problems – Producer Consumer, Dining Philosophers and Readers-Writers Problems</td>
<td>9 15%</td>
</tr>
<tr>
<td>IV</td>
<td><strong>CPU Scheduling:</strong> Scheduling Criteria – Scheduling Algorithms. <strong>Deadlocks:</strong> Conditions, Modeling using graphs. Handling – Prevention – Avoidance – Detection – Recovery.</td>
<td>8 15%</td>
</tr>
<tr>
<td>V</td>
<td><strong>Memory Management:</strong> Main Memory – Swapping – Contiguous Memory allocation – Segmentation – Paging – Demand paging</td>
<td>9 20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**
Question Paper Pattern:

1. There will be five parts in the question paper – A, B, C, D, E
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   b. Four questions each having 3 marks, uniformly covering module III and IV; All four questions have to be answered.
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   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering module III and IV; Two questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions.
Course code | Course Name | L-T-P - Credits | Year of Introduction  
---|---|---|---
CS206 | Object Oriented Design and Programming | 2-1-0-3 | 2016 |

**Pre-requisite:** CS205 Data structures

**Course Objectives**

1. To introduce basic concepts of object oriented design techniques.
2. To give a thorough understanding of Java language.
3. To provide basic exposure to the basics of multithreading, database connectivity etc.
4. To impart the techniques of creating GUI based applications.

**Syllabus**

Object oriented concepts, Object oriented systems development life cycle, Unified Modeling Language, Java Overview, Classes and objects, Parameter passing, Overloading, Inheritance, Overriding, Packages, Exception Handling, Input/Output, Threads and multithreading, Applets, Event Handling mechanism, Working with frames and graphics, AWT Controls, Swings, Java database connectivity.

**Expected outcome**

Students will be able to:

1. apply object oriented principles in software design process.
2. develop Java programs for real applications using java constructs and libraries.
3. understand and apply various object oriented features like inheritance, data abstraction, encapsulation and polymorphism to solve various computing problems using Java language.
4. implement Exception Handling in java.
5. use graphical user interface and Event Handling in java.
6. develop and deploy Applet in java.

**Text Books:**


**References:**

3. Flanagan D., Java in A Nutshell, 5/e, O'Reilly, 2005.
5. Sierra K., Head First Java, 2/e, O'Reilly, 2005.
7. 

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours (42)</th>
<th>Sem. ExamMarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Object oriented concepts, Object oriented systems development life cycle. Unified Modeling Language, UML class diagram, Use-case diagram. Java Overview: Java virtual machine, data types, operators, control statements, Introduction to Java programming.</td>
<td>08</td>
<td>15%</td>
</tr>
<tr>
<td>Module</td>
<td>Topics</td>
<td>Marks</td>
<td>Percentage</td>
</tr>
<tr>
<td>--------</td>
<td>------------------------------------------------------------------------</td>
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<td>------------</td>
</tr>
<tr>
<td>II</td>
<td>Classes fundamentals, objects, methods, constructors, parameter passing, overloading, access control keywords.</td>
<td>07</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Inheritance basics, method overriding, abstract classes, interface. Defining and importing packages. Exception handling fundamentals, multiple catch and nested try statements.</td>
<td>06</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Input/Output: files, stream classes, reading console input. Threads: thread model, use of Thread class and Runnable interface, thread synchronization, multithreading.</td>
<td>06</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>String class - basics. Applet basics and methods. Event Handling: delegation event model, event classes, sources, listeners.</td>
<td>07</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Introduction to AWT: working with frames, graphics, color, font. AWT Control fundamentals. Swing overview. Java database connectivity: JDBC overview, creating and executing queries, dynamic queries.</td>
<td>08</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**Question Paper Pattern:**

1. There will be five parts in the question paper – A, B, C, D, E
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   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having 9 marks, uniformly covering module III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/design questions.
Course code | Course Name | L-T-P - Credits | Year of Introduction
---|---|---|---
CS208 | Principles of Database Design | 2-1-0-3 | 2016

**Pre-requisite:** CS205 Data structures

**Course Objectives**
- To impart the basic understanding of the theory and applications of database management systems.
- To give basic level understanding of internals of database systems.
- To expose to some of the recent trends in databases.

**Syllabus:**
Types of data, database and DBMS, Languages and users, Software Architecture, E-R and Extended E-R Modelling, Relational Model – concepts and languages, relational algebra and tuple relational calculus, SQL, views, assertions and triggers, relational db design, FDs and normal forms, Secondary storage organization, indexing and hashing, query optimization, concurrent transaction processing and recovery principles, recent topics.

**Expected outcome.**
Students will be able to:
1. define, explain and illustrate the fundamental concepts of databases.
2. construct an Entity-Relationship (E-R) model from specifications and to perform the transformation of the conceptual model into corresponding logical data structures.
3. model and design a relational database following the design principles.
4. develop queries for relational database in the context of practical applications
5. define, explain and illustrate fundamental principles of data organization, query optimization and concurrent transaction processing.
6. appreciate the latest trends in databases.

**Text Books:**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours (42)</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Introduction:</strong> Data: structured, semi-structured and unstructured data, Concept &amp; Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS. Database architectures and classification. (Reading: Elmasri Navathe, Ch. 1 and 2. Additional Reading: Silbershatz, Korth, Ch. 1) <strong>Entity-Relationship Model:</strong> Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-</td>
<td>06</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Relationship Diagram, Weak Entity Sets, Relationships of degree greater than 2 (Reading: Elmasri Navathe, Ch. 7.1-7.8)</td>
<td>06</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Relational Model: Structure of relational Databases, Integrity Constraints, synthesizing ER diagram to relational schema (Reading: Elmasri Navathe, Ch. 3 and 8.1, Additional Reading: Silbershatz, Korth, Ch. 2.1-2.4) Database Languages: Concept of DDL and DML relational algebra (Reading: Silbershatz, Korth, Ch 2.5-2.6 and 6.1-6.2, Elmasri Navathe, Ch. 6.1-6.5)</td>
<td>07</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Structured Query Language (SQL): Basic SQL Structure, examples, Set operations, Aggregate Functions, nested sub-queries (Reading: Elmasri Navathe, Ch. 4 and 5.1) Views, assertions and triggers (Reading: Elmasri Navathe, Ch. 5.2-5.3, Optional reading: Silbershatz, Korth Ch. 5.3).</td>
<td>07</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Relational Database Design: Different anomalies in designing a database, normalization, functional dependency (FD), Armstrong’s Axioms, closures, Equivalence of FDs, minimal Cover (proofs not required). Normalization using functional dependencies, INF, 2NF, 3NF and BCNF, lossless and dependency preserving decompositions (Reading: Elmasri and Navathe, Ch. 14.1-14.5, 15.1-15.2. Additional Reading: Silbershatz, Korth Ch. 8.1-8.5)</td>
<td>07</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Physical Data Organization: index structures, primary, secondary and clustering indices, Single level and Multi-level indexing, B+-Trees (basic structure only, algorithms not needed), (Reading Elmasri and Navathe, Ch. 17.1-17.4) Query Optimization: heuristics-based query optimization, (Reading Elmasri and Navathe, Ch. 18.1, 18.7)</td>
<td>09</td>
<td>20%</td>
</tr>
</tbody>
</table>

END SEMESTER EXAM
Question Paper Pattern:

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   a. Total marks : 18
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   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering module III and IV; *All* *four* questions have to be answered.
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   a. Total marks : 18
   b. *Three* questions each having 9 marks, uniformly covering module III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions.
<table>
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<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>HS210</td>
<td>LIFE SKILLS</td>
<td>2-0-2</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite : Nil**

**Course Objectives**

- To develop communication competence in prospective engineers.
- To enable them to convey thoughts and ideas with clarity and focus.
- To develop report writing skills.
- To equip them to face interview & Group Discussion.
- To inculcate critical thinking process.
- To prepare them on problem solving skills.
- To provide symbolic, verbal, and graphical interpretations of statements in a problem description.
- To understand team dynamics & effectiveness.
- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values, Loyalty and also to learn to appreciate the rights of others.
- To learn leadership qualities and practice them.

**Syllabus**


**Critical Thinking & Problem Solving:** Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats, Mind Mapping & Analytical Thinking.

**Teamwork:** Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts.

**Ethics, Moral & Professional Values:** Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE.

**Leadership Skills:** Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation.

**Expected outcome**

The students will be able to

- Communicate effectively.
- Make effective presentations.
- Write different types of reports.
- Face interview & group discussion.
- Critically think on a particular problem.
- Solve problems.
- Work in Group & Teams
- Handle Engineering Ethics and Human Values.
- Become an effective leader.
Resource Book:


References:

- Shalini Verma (2014); “Development of Life Skills and Professional Practice”; First Edition; Sultan Chand (G/L) & Company
- John C. Maxwell (2014); “The 5 Levels of Leadership”, Centre Street, A division of Hachette Book Group Inc.

| Course Plan |
|-------------|---------|---------|---------|
| Module | Contents | Hours | Sem. Exam Marks |
| | | L-T-P | |
| I | Need for Effective Communication, Levels of communication; Flow of communication; Use of language in communication; Communication networks; Significance of technical communication, Types of barriers; Miscommunication; Noise; Overcoming measures, Listening as an active skill; Types of Listeners; Listening for general content; Listening to fill up information; Intensive Listening; Listening for specific information; Developing effective listening skills; Barriers to effective listening skills. | L T P | |
| | Technical Writing: Differences between technical and literary style, Elements of style; Common Errors, Letter Writing: Formal, informal and demi-official letters; business letters, Job Application: Cover letter, Differences between bio-data, CV and Resume, Report Writing: Basics of Report Writing; Structure of a report; Types of reports. | | |
| Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language | | | |
| Interview Skills: Types of Interviews; Ensuring success in job interviews; Appropriate use of non-verbal communication, Group Discussion: Differences between group discussion and debate; Ensuring success in group discussions, Presentation Skills: Oral presentation and public speaking skills; business presentations, Technology-based Communication: Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software. | | | See evaluation scheme |
| II | Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity  
Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.  
Steps in problem solving, Problem Solving Techniques, Problem Solving through Six Thinking Hats, Mind Mapping, Forced Connections.  
Problem Solving strategies, Analytical Thinking and quantitative reasoning expressed in written form, Numeric, symbolic, and graphic reasoning, Solving application problems. | 2 |
| III | Introduction to Groups and Teams, Team Composition, Managing Team Performance, Importance of Group, Stages of Group, Group Cycle, Group thinking, getting acquainted, Clarifying expectations.  
Group Problem Solving, Achieving Group Consensus.  
Group Dynamics techniques, Group vs Team, Team Dynamics, Teams for enhancing productivity, Building & Managing Successful Virtual Teams. Managing Team Performance & Managing Conflict in Teams.  
Working Together in Teams, Team Decision-Making, Team Culture & Power, Team Leader Development. | 3 |
| IV | Morals, Values and Ethics, Integrity, Work Ethic, Service Learning, Civic Virtue, Respect for Others, Living Peacefully.  
Caring, Sharing, Honesty, Courage, Valuing Time, Cooperation, Commitment, Empathy, Self-Confidence, Character Spirituality, Senses of 'Engineering Ethics', variety of moral issued, Types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, Consensus and controversy, Models of Professional Roles, Theories about right action, Self-interest, customs and religion, application of ethical theories.  
Engineering as experimentation, engineers as responsible experimenters, Codes of ethics, Balanced outlook on.  
The challenger case study, Multinational corporations, Environmental ethics, computer ethics, | 3 |
Weapons development, engineers as managers, consulting engineers, engineers as expert witnesses and advisors, moral leadership, sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers(India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers(IETE), India, etc.

Introduction, a framework for considering leadership, entrepreneurial and moral leadership, vision, people selection and development, cultural dimensions of leadership, style, followers, crises.

Growing as a leader, turnaround leadership, gaining control, trust, managing diverse stakeholders, crisis management.

Implications of national culture and multicultural leadership Types of Leadership, Leadership Traits.

Leadership Styles, VUCA Leadership, DART Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders, making of a Leader, Formulate Leadership

END SEMESTER EXAM

EVALUATION SCHEME

Internal Evaluation
(Conducted by the College)

Total Marks: 100

Part – A

(To be started after completion of Module 1 and to be completed by 30th working day of the semester)

1. Group Discussion – Create groups of about 10 students each and engage them on a GD on a suitable topic for about 20 minutes. Parameters to be used for evaluation is as follows:

   (i) Communication Skills – 10 marks
   (ii) Subject Clarity – 10 marks
   (iii) Group Dynamics - 10 marks
   (iv) Behaviors & Mannerisms - 10 marks

   (Marks: 40)
Part – B

(To be started from 31st working day and to be completed before 60th working day of the semester)

2. Presentation Skills – Identify a suitable topic and ask the students to prepare a presentation (preferably a power point presentation) for about 10 minutes. Parameters to be used for evaluation is as follows;

(i) Communication Skills* - 10 marks
(ii) Platform Skills** - 10 marks
(iii) Subject Clarity/Knowledge - 10 marks

(Marks: 30)

* Language fluency, auditability, voice modulation, rate of speech, listening, summarizes key learnings etc.

** Postures/Gestures, Smiles/Expressions, Movements, usage of floor area etc.

Part – C

(To be conducted before the termination of semester)

3. Sample Letter writing or report writing following the guidelines and procedures. Parameters to be used for evaluation is as follows;

(i) Usage of English & Grammar - 10 marks
(ii) Following the format - 10 marks
(iii) Content clarity - 10 marks

(Marks: 30)

External Evaluation

(Conducted by the University)

Total Marks: 50

Time: 2 hrs.

Part – A

Short Answer questions

There will be one question from each area (five questions in total). Each question should be written in about maximum of 400 words. Parameters to be used for evaluation are as follows;

(i) Content Clarity/Subject Knowledge
(ii) Presentation style
(iii) Organization of content
Part – B

Case Study

The students will be given a case study with questions at the end. The students have to analyze the case and answer the question at the end. Parameters to be used for evaluation are as follows:

(i) Analyze the case situation  
(ii) Key players/characters of the case  
(iii) Identification of the problem (both major & minor if exists)  
(iv) Bring out alternatives  
(v) Analyze each alternative against the problem  
(vi) Choose the best alternative  
(vii) Implement as solution  
(viii) Conclusion  
(ix) Answer the question at the end of the case
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS232</td>
<td>Free and Open Source Software Lab</td>
<td>0-0-3-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

Pre-requisite: CS204 Operating systems

Course Objectives: To expose students to FOSS environment and introduce them to use open source packages in open source platform.

List of Exercises/Experiments:
1. Getting started with Linux basic commands for directory operations, displaying directory structure in tree format etc.
2. Linux commands for operations such as redirection, pipes, filters, job control, changing ownership/permissions of files/links/directory.
3. Advanced Linux commands curl, wget, ftp, ssh and grep
4. Shell Programming: Write shell script to show various system configuration like
   - Currently logged user and his login name
   - Your current shell
   - Your home directory
   - Your operating system type
   - Your current path setting
   - Your current working directory
   - Number of users currently logged in
5. Write shell script to show various system configurations like
   - your OS and version, release number, kernel version
   - all available shells
   - computer CPU information like processor type, speed etc
   - memory information
   - hard disk information like size of hard-disk, cache memory, model etc
   - File system (Mounted)
6. Write a shell script to implement a menu driven calculator with following functions
   1. Addition
   2. Subtraction
   3. Multiplication
   4. Division
   5. Modulus
7. Write a script called addnames that is to be called as follows
   
   ```
   ./addnames ulist username
   ```
   Here ulist is the name of the file that contains list of user names and username is a particular student's username. The script should
   - check that the correct number of arguments was received and print a message, in case the number of arguments is incorrect
   - check whether the ulist file exists and print an error message if it does not
   - check whether the username already exists in the file. If the username exists, print a message stating that the name already exists. Otherwise, add the username to the end of the list.
8. Version Control System setup and usage using GIT. Try the following features.
   - Creating a repository
   - Checking out a repository
   - Adding content to the repository
   - Committing the data to a repository
   - Updating the local copy
   - Comparing different revisions
   - Revert
   - Conflicts and a conflict Resolution

9. Shell script which starts on system boot up and kills every process which uses more than a specified amount of memory or CPU.

10. Introduction to packet management system: Given a set of RPM or DEB, build and maintain, and serve packages over http or ftp. Configure client systems to access the package repository.


12. Running PHP: simple applications like login forms after setting up a LAMP stack

13. Virtualisation environment (e.g., xen, kqemu, virtualbox or lguest) to test applications, new kernels and isolate applications. It could also be used to expose students to other alternate OS such as freeBSD

14. Compiling from source: learn about the various build systems used like the auto* family, cmake, ant etc. instead of just running the commands. This could involve the full process like fetching from a cvs and also include autoconf, automake etc.,

15. Kernel configuration, compilation and installation: Download / access the latest kernel source code from kernel.org, compile the kernel and install it in the local system. Try to view the source code of the kernel

16. GUI Programming: Create scientific calculator – using any one of Gambas, GTK, QT

17. Installing various software packages. Either the package is yet to be installed or an older version is present. The student can practice installing the latest version. (Internet access is needed).
   - Install samba and share files to windows
   - Install Common Unix Printing System (CUPS)

18. Set up the complete network interface by configuring services such as gateway, DNS, IP tables etc. using ifconfig

**Expected outcome:**
The students will be able to:
1. Identify and apply various Linux commands
2. Develop shell scripts and GUI for specific needs
3. Use tools like GIT
4. Perform basic level application deployment, kernel configuration and installation, packet management and installation etc.
<table>
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<th>Year of Introduction</th>
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<tbody>
<tr>
<td>CS234</td>
<td>DIGITAL SYSTEMS LAB</td>
<td>0-0-3-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Pre-requisite:** CS203 Switching theory and logic design

**Course Objectives:**
1. To familiarize students with digital ICs, the building blocks of digital circuits
2. To provide students the opportunity to set up different types of digital circuits and study their behaviour

**List of Exercises/Experiments:** (minimum 12 exercises/experiments are mandatory)
1. Familiarizations and verification of the truth tables of basic gates and universal gates.
2. Verification of Demorgan's laws for two variables.
3. Implementation of half adder and full adder circuits using logic gates.
4. Implementation of half subtractor and full subtractor circuits using logic gates.
5. Implementation of parallel adder circuit.
6. Realization of 4 bit adder/subtractor and BCD adder circuits using IC 7483.
8. Design and implementation of code convertor circuits
9. a) BCD to excess 3 code b) binary to gray code
10. Implementation of multiplexer and demultiplexer circuits using logic gates. Familiarization with various multiplexer and demultiplexer ICs.
11. Realization of combinational circuits using multiplexer/demultiplexer ICs.
12. Implementation of SR, D, JK, JK master slave and T flip flops using logic gates. Familiarization with IC 7474 and IC 7476.
15. Realization of asynchronous counters using flip flop ICs.
17. Implementation of a BCD to 7 segment decoder and display.
18. Simulation of Half adder, Full adder using VHDL.
   
   *(Note: The experiments may be done using hardware components and/or VHDL)*

**Course outcome:**
Students will be able to:
1. identify and explain the digital ICs and their use in implementing digital circuits.
2. design and implement different kinds of digital circuits.
<table>
<thead>
<tr>
<th>Course code</th>
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<tbody>
<tr>
<td>CS301</td>
<td>THEORY OF COMPUTATION</td>
<td>3-1-0-4</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite: Nil

**Course Objectives**
- To introduce the concept of formal languages.
- To discuss the Chomsky classification of formal languages with discussion on grammar and automata for regular, context-free, context sensitive and unrestricted languages.
- To discuss the notions of decidability and halting problem.

**Syllabus**
Introduction to Automata Theory, Structure of an automaton, classification of automata, grammar and automata for generating each class of formal languages in the Chomsky Hierarchy, decidability and Halting problem.

**Expected Outcome**
The Students will be able to
i. Classify formal languages into regular, context-free, context sensitive and unrestricted languages.
ii. Design finite state automata, regular grammar, regular expression and Myhill-Nerode relation representations for regular languages.
iii. Design push-down automata and context-free grammar representations for context-free languages.
iv. Design Turing Machines for accepting recursively enumerable languages.
v. Understand the notions of decidability and undecidability of problems, Halting problem.

**Text Books**

**References**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
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<th>End Sem. Exam Marks</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>Introduction to Automata Theory and its significance. <strong>Type 3 Formalism:</strong> Finite state automata – Properties of transition functions, Designing finite automata, NFA, Finite Automata with Epsilon Transitions, Equivalence of NFA and DFA, Conversion of NFA to DFA, Equivalence and Conversion of NFA with and without Epsilon Transitions.</td>
<td>10</td>
<td>15 %</td>
</tr>
<tr>
<td>II</td>
<td>Myhill-Nerode Theorem, Minimal State FA Computation. Finite State Machines with Output- Mealy and Moore machine (Design Only), Two- Way Finite Automata. Regular Grammar, Regular Expressions, Equivalence of regular expressions and NFA with epsilon transitions. Converting Regular Expressions to NFA with epsilon transitions Equivalence of DFA and regular expressions, converting DFA to Regular Expressions.</td>
<td>10</td>
<td>15 %</td>
</tr>
</tbody>
</table>
FIRST INTERNAL EXAM

| III | Pumping Lemma for Regular Languages, Applications of Pumping Lemma. Closure Properties of Regular sets (Proofs not required), Decision Problems related with Type 3 Formalism | 09 | 15 % |
| IV | Non-Deterministic Pushdown Automata (NPDA), design. Equivalence of acceptance by final state and empty stack in PDA. Equivalence between NPDA and CFG, Deterministic Push Down Automata, Closure properties of CFLs (Proof not required), Decision Problems related with Type 3 Formalism. | 08 | 15 % |

SECOND INTERNAL EXAM

| V | Pumping Lemma for CFLs, Applications of Pumping Lemma. Type 1 Formalism: Context-sensitive Grammar. Linear Bounded Automata (Design not required) Type 0 Formalism: Turing Machine (TM) – Basics and formal definition, TMs as language acceptors, TMs as Transducers, Designing Turing Machines. | 09 | 20 % |
| VI | Variants of TMs -Universal Turing Machine, Multi-tape TMs, Non Deterministic TMs, Enumeration Machine (Equivalence not required), Recursively Enumerable Languages, Recursive languages, Properties of Recursively Enumerable Languages and Recursive Languages, Decidability and Halting Problem. Chomsky Hierarchy | 08 | 20 % |

END SEMESTER EXAM

Question Paper Pattern
1. There will be five parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12   b. Four questions each having 3 marks, uniformly covering modules I and II; All four questions have to be answered.
3. Part B
   a. Total marks : 18   b. Three questions each having 9 marks, uniformly covering modules I and II; Two questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12   b. Four questions each having 3 marks, uniformly covering modules III and IV; All four questions have to be answered.
5. Part D
   a. Total marks : 18   b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts.
6. Part E
   a. Total Marks: 40   b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered. A question can have a maximum of three sub-parts.

There should be at least 60% analytical/numerical questions.
Course code | Course Name | L-T-P Credits | Year of Introduction
---|---|---|---
CS303 | SYSTEM SOFTWARE | 2-1-0-3 | 2016

Prerequisite: Nil

Course Objectives
- To make students understand the design concepts of various system software like Assembler, Linker, Loader and Macro pre-processor, Utility Programs such as Text Editor and Debugger.

Syllabus

Expected Outcome
The Students will be able to
i. distinguish different software into different categories.
ii. design, analyze and implement one pass, two pass or multi pass assembler.
iii. design, analyze and implement loader and linker.
iv. design, analyze and implement macro processors.
v. critique the features of modern editing /debugging tools.

Text book

References

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem Exam. Marks</th>
</tr>
</thead>
</table>

**I**  
**Introduction:**  
System Software Vs. Application Software, Different System Software– Assembler, Linker, Loader, Macro Processor, Text Editor, Debugger, Device Driver, Compiler, Interpreter, Operating System(Basic Concepts only)  

**II**  
**Assemblers**  

**FIRST INTERNAL EXAM**  
**III**  
**Assembler design options:**  
Machine Independent assembler features – program blocks, Control sections, Assembler design options- Algorithm for Single Pass assembler, Multi pass assembler, Implementation example of MASM Assembler  

**IV**  
**Linker and Loader**  

**SECOND INTERNAL EXAM**  
**V**  
**Macro Preprocessor:**  
Macro Instruction Definition and Expansion. One pass Macro processor Algorithm and data structures, Machine Independent Macro Processor Features, Macro processor design options  

**VI**  
**Device drivers:**  
Anatomy of a device driver, Character and block device drivers, General design of device drivers  

**Text Editors:**  
Overview of Editing, User Interface, Editor Structure.  

**Debuggers :-**  
Debugging Functions and Capabilities, Relationship with other parts of the system, Debugging Methods- By Induction, Deduction and Backtracking.  

**END SEMESTER EXAM**
Question Paper Pattern

1. There will be five parts in the question paper – A, B, C, D, E

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   a. Total marks : 12
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   b. Three questions each having 9 marks, uniformly covering modules I and II; Two questions have to be answered. Each question can have a maximum of three subparts.

4. Part C
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering modules III and IV; All four questions have to be answered.

5. Part D
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts

6. Part E
   a. Total Marks: 40
   b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.
<table>
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</tr>
</thead>
<tbody>
<tr>
<td>CS305</td>
<td>Microprocessors and Microcontrollers</td>
<td>2-1-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** CS202 Computer Organisation and Architecture

**Course Objectives**
- To impart basic understanding of the internal organisation of 8086 Microprocessor and 8051 microcontroller.
- To introduce the concepts of interfacing microprocessors with external devices.
- To develop Assembly language programming skills.

**Syllabus**
Introduction to 8086 Microprocessor; Architecture and signals, Instruction set of 8086, Timing Diagram, Assembly Language Programming, Memory and I/O interfacing, Interfacing with 8255, 8279, 8257, Interrupts and Interrupt handling, Microcontrollers - 8051 Architecture and its salient features, Instruction Set and Simple Programming Concepts.

**Expected Outcome**
The Students will be able to
i. Describe different modes of operations of a typical microprocessor and microcontroller.
ii. Design and develop 8086 assembly language programs using software interrupts and various assembler directives.
iii. Interface microprocessors with various external devices.
iv. Analyze and compare the features of microprocessors and microcontrollers.
v. Design and develop assembly language programs using 8051 microcontroller.

**Text Books**

**References**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Evolution of microprocessors, 8086 Microprocessor - Architecture and signals, Memory organisation, Minimum and maximum mode of operation, Minimum mode Timing Diagram. Comparison of 8086 and 8088.</td>
<td>07</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>8086 Addressing Modes, 8086 Instruction set and Assembler Directives - Assembly Language Programming with Subroutines, Macros, Passing Parameters, Use of stack.</td>
<td>08</td>
<td>15%</td>
</tr>
</tbody>
</table>
FIRST INTERNAL EXAM

| III | Interrupts - Types of Interrupts and Interrupt Service Routine. Handling Interrupts in 8086, Interrupt programming. Basic Peripherals and their Interfacing with 8086 - Programmable Interrupt Controller - 8259 - Architecture. | 07 | 15% |

| IV | Interfacing Memory, I/O, 8255 - Detailed study - Architecture, Control word format and modes of operation, Architecture and modes of operation of 8279 and 8257 (Just mention the control word, no need to memorize the control word format) | 07 | 15% |

SECOND INTERNAL EXAM

| V | Microcontrollers - Types of Microcontrollers - Criteria for selecting a microcontroller - Example Applications. Characteristics and Resources of a microcontroller. Organization and design of these resources in a typical microcontroller - 8051. 8051 Architecture, Register Organization, Memory and I/O addressing, Interrupts and Stack. | 08 | 20% |

| VI | 8051 Addressing Modes, Different types of instructions and Instruction Set, Simple programs. Peripheral Chips for timing control - 8254/8253. | 08 | 20% |

END SEMESTER EXAM

**Question Paper Pattern**

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   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules I and II; *All four* questions have to be answered.
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   a. Total marks : 18
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6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
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</tr>
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<tbody>
<tr>
<td>CS307</td>
<td>DATA COMMUNICATION</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite: Nil

**Course Objectives**
- To introduce fundamental communication models.
- To discuss various time domain and frequency domain concepts of data communication.
- To introduce the concepts of encoding, multiplexing and spread spectrum.

**Syllabus**

**Expected Outcome**
The Students will be able to
- i. Identify and list the various issues present in the design of a data communication system.
- ii. Apply the time domain and frequency domain concepts of signals in data communication.
- iii. Compare and select transmission media based on transmission impairments and channel capacity.
- iv. Select and use appropriate signal encoding techniques and multiplexing techniques for a given scenario.
- v. Design suitable error detection and error correction algorithms to achieve error free data communication and explain different switching techniques.

**Text Books**
1. Curt M. White, Fundamentals of Networking and Communication 7/e, Cengage learning. [Chapter 3,4,9,10]
2. Forouzan B. A., Data Communications and Networking, 5/e, Tata McGraw Hill, 2013. [Chapters:3,4, 5, 6,7,8]
3. Schiller J., Mobile Communications, 2/e, Pearson Education, 2009. [Chapters:2,3]
4. William Stallings, Data and Computer Communication 9/e, Pearson Education, Inc. [Chapters: 4, 5, 6, 7, 8, 9].

**References**

**COURSE PLAN**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
</table>

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<thead>
<tr>
<th>Part</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>IV</td>
<td>Multiplexing- Space Division Multiplexing-Frequency Division Multiplexing: Wave length Division Multiplexing - Time Division multiplexing: Characteristics, Digital Carrier system, SONET/SDH-Statistical time division multiplexing: Cable Modem - Code Division Multiplexing. Multiple Access – CDMA.</td>
</tr>
<tr>
<td>V</td>
<td>Digital Data Communication Techniques - Asynchronous transmission, Synchronous transmission-Detecting and Correcting Errors-Types of Errors- Error Detection: Parity check, Cyclic Redundancy Check (CRC)- Error Control Error Correction: Forward Error Correction and Hamming Distance.</td>
</tr>
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</table>

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   b. *Four* questions each having 3 marks, uniformly covering modules III and IV; *All four* questions have to be answered.

5. Part D
   a. Total marks: 18
   b. *Three* questions each having 9 marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts.

6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.
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<tbody>
<tr>
<td>CS309</td>
<td>GRAPH THEORY AND COMBINATORICS</td>
<td>2-0-2-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite: Nil

**Course Objectives**
- To introduce the fundamental concepts in graph theory, including properties and characterization of graphs/ trees and Graphs theoretic algorithms

**Syllabus**
Introductory concepts of graphs, Euler and Hamiltonian graphs, Planar Graphs, Trees, Vertex connectivity and edge connectivity, Cut set and Cut vertices, Matrix representation of graphs, Graphs theoretic algorithms.

**Expected Outcome**
The Students will be able to
i. Demonstrate the knowledge of fundamental concepts in graph theory, including properties and characterization of graphs and trees.
ii. Use graphs for solving real life problems.
iii. Distinguish between planar and non-planar graphs and solve problems.
iv. Develop efficient algorithms for graph related problems in different domains of engineering and science.

**Text Books**
1. Douglas B. West, Introduction to Graph Theory, Prentice Hall India Ltd., 2001
2. Narasingh Deo, Graph theory, PHI, 1979.
3. Robin J. Wilson, Introduction to Graph Theory, Longman Group Ltd., 2010

**References**

<table>
<thead>
<tr>
<th>Module</th>
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<th>Hours</th>
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</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Introductory concepts</strong> - What is graph – Application of graphs – finite and infinite graphs – Incidence and Degree – Isolated vertex, pendent vertex and Null graph. Paths and circuits – Isomorphism, sub graphs, walks, paths and circuits, Connected graphs, disconnect graphs.</td>
<td>09</td>
<td>15 %</td>
</tr>
<tr>
<td>II</td>
<td>Euler graphs, Hamiltonian paths and circuits, Dirac's theorem for Hamiltonicity, Travelling salesman problem. Directed graphs – types of digraphs, Digraphs and binary relation</td>
<td>10</td>
<td>15 %</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAM**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Trees – properties, pendent vertex. Distance and centres - Rooted and binary tree, counting trees, spanning trees.</td>
<td>07</td>
<td>15 %</td>
</tr>
<tr>
<td>IV</td>
<td>Vertex Connectivity, Edge Connectivity, Cut set and Cut Vertices, Fundamental circuits, Planar graphs, Different representation of planar graphs, Euler's theorem, Geometric dual, Combinatorial dual.</td>
<td>09</td>
<td>15 %</td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAM**
<table>
<thead>
<tr>
<th>V</th>
<th>Matrix representation of graphs - Adjacency matrix, Incidence Matrix, Circuit matrix, Fundamental Circuit matrix and Rank, Cut set matrix, Path matrix</th>
<th>08</th>
<th>20 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI</td>
<td>Graphs theoretic algorithms - Algorithm for computer representation of a graph, algorithm for connectedness and components, spanning tree, shortest path.</td>
<td>07</td>
<td>20 %</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**Question Paper Pattern**
1. There will be five parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering modules I and II; All four questions have to be answered.
3. Part B
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules I and II; Two questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering modules III and IV; All four questions have to be answered.
5. Part D
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts.
6. Part E
   a. Total Marks: 40
   b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.
**Course code**  
**Course Name**  
**L-T-P - Credits**  
**Year of Introduction**

<table>
<thead>
<tr>
<th><strong>341</strong></th>
<th><strong>DESIGN PROJECT</strong></th>
<th><strong>0-1-2-2</strong></th>
<th><strong>2016</strong></th>
</tr>
</thead>
</table>

**Prerequisite**: Nil

**Course Objectives**
- To understand the engineering aspects of design with reference to simple products
- To foster innovation in design of products, processes or systems
- To develop design that add value to products and solve technical problems

**Course Plan**

**Study**: Take minimum three simple products, processes or techniques in the area of specialisation, study, analyse and present them. The analysis shall be focused on functionality, strength, material, manufacture/construction, quality, reliability, aesthetics, ergonomics, safety, maintenance, handling, sustainability, cost etc., whichever are applicable. Each student in the group has to present individually; choosing different products, processes or techniques.

**Design**: The project team shall identify an innovative product, process or technology and proceed with detailed design. At the end, the team has to document it properly and present and defend it. The design is expected to concentrate on functionality, design for strength is not expected.

**Note**: The one hour/week allotted for tutorial shall be used for discussions and presentations. The project team (not exceeding four) can be students from different branches, if the design problem is multidisciplinary.

**Expected outcome.**
The students will be able to

- i. Think innovatively on the development of components, products, processes or technologies in the engineering field
- ii. Analyse the problem requirements and arrive workable design solutions

**Reference:**

**Evaluation**

- First evaluation (Immediately after first internal examination) 20 marks
- Second evaluation (Immediately after second internal examination) 20 marks
- Final evaluation (Last week of the semester) 60 marks

**Note**: All the three evaluations are mandatory for course completion and for awarding the final grade.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS331</td>
<td>SYSTEM SOFTWARE LAB</td>
<td>0-0-3-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite: Nil**

**Course Objectives**
- To build an understanding on design and implementation of different types of system software.

**List of Exercises/Experiments:** (Exercises/experiments marked with * are mandatory from each part. Total 12 Exercises/experiments are mandatory)

*Part A*
1. Simulate the following non-preemptive CPU scheduling algorithms to find turnaround time and waiting time.
   - a) FCFS
   - b) SJF
   - c) Round Robin (pre-emptive)
   - d) Priority
2. Simulate the following file allocation strategies.
   - a) Sequential
   - b) Indexed
   - c) Linked
3. Implement the different paging techniques of memory management.
4. Simulate the following file organization techniques *
   - a) Single level directory
   - b) Two level directory
   - c) Hierarchical
5. Implement the banker’s algorithm for deadlock avoidance.*
6. Simulate the following disk scheduling algorithms.
   - a) FCFS
   - b) SCAN
   - c) C-SCAN
7. Simulate the following page replacement algorithms
   - a) FIFO
   - b) LRU
   - c) LFU
8. Implement the producer-consumer problem using semaphores.*
9. Write a program to simulate the working of the dining philosopher’s problem.*

*Part B*
10. Implement the symbol table functions: create, insert, modify, search, and display.
11. Implement pass one of a two pass assembler.*
12. Implement pass two of a two pass assembler.*
13. Implement a single pass assembler.*
14. Implement a two pass macro processor.*
15. Implement a single pass macro processor.
16. Implement an absolute loader.
17. Implement a relocating loader.
18. Implement pass one of a direct-linking loader.
19. Implement pass two of a direct-linking loader.
20. Implement a simple text editor with features like insertion / deletion of a character, word, and sentence.
21. Implement a symbol table with suitable hashing.*
**Expected Outcome**
The students will be able to

i. Compare and analyze CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority.

ii. Implement basic memory management schemes like paging.

iii. Implement synchronization techniques using semaphores etc.

iv. Implement banker’s algorithm for deadlock avoidance.

v. Implement memory management schemes and page replacement schemes and file allocation and organization techniques.

vi. Implement system software such as loaders, assemblers and macro processor.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS333</td>
<td>APPLICATION SOFTWARE DEVELOPMENT LAB</td>
<td>0-0-3-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Pre-requisite : CS208 Principles of Database Design**

**Course Objectives**
- To introduce basic commands and operations on database.
- To introduce stored programming concepts (PL-SQL) using Cursors and Triggers.
- To familiarize front end tools of database.

**List of Exercises/Experiments:** (Exercises/experiments marked with * are mandatory. Total 12 Exercises/experiments are mandatory)

1. Creation of a database using DDL commands and writes DQL queries to retrieve information from the database.
2. Performing DML commands like Insertion, Deletion, Modifying, Altering, and Updating records based on conditions.
3. Creating relationship between the databases. *
4. Creating a database to set various constraints. *
5. Practice of SQL TCL commands like Rollback, Commit, Savepoint.
6. Practice of SQL DCL commands for granting and revoking user privileges.
7. Creation of Views and Assertions *
8. Implementation of Build in functions in RDBMS *
9. Implementation of various aggregate functions in SQL *
10. Implementation of Order By, Group By & Having clause. *
11. Implementation of set operators, nested queries and Join queries *
12. Implementation of various control structures using PL/SQL *
13. Creation of Procedures and Functions *
14. Creation of Packages *
15. Creation of database Triggers and Cursors *
16. Practice various front-end tools and report generation.
17. Creating Forms and Menus
18. Mini project (Application Development using Oracle/ MySQL using Database connectivity)*
   a. Inventory Control System.
   b. Material Requirement Processing.
   c. Hospital Management System.
   d. Railway Reservation System.
   e. Personal Information System.
   f. Web Based User Identification System.
   g. Timetable Management System.
   h. Hotel Management System.

**Expected Outcome**
The students will be able to
- i. Design and implement a database for a given problem using database design principles.
- ii. Apply stored programming concepts (PL-SQL) using Cursors and Triggers.
- iii. Use graphical user interface, Event Handling and Database connectivity to develop and deploy applications and applets.
- iv. Develop medium-sized project in a team.
Course Objectives
- To introduce the concepts in Soft Computing such as Artificial Neural Networks, Fuzzy logic-based systems, genetic algorithm-based systems and their hybrids.

Syllabus
Introduction to Soft Computing, Artificial Neural Networks, Fuzzy Logic and Fuzzy systems, Genetic Algorithms, hybrid systems.

Expected Outcome
The Students will be able to
1. Learn soft computing techniques and their applications.
2. Analyze various neural network architectures.
3. Define the fuzzy systems.
4. Understand the genetic algorithm concepts and their applications.
5. Identify and select a suitable Soft Computing technology to solve the problem; construct a solution and implement a Soft Computing solution.

Text Books

References

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to Soft Computing</td>
<td>07</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Perceptron networks – Learning rule – Training and testing algorithm, Adaptive Linear Neuron, Back propagation Network – Architecture, Training algorithm</td>
<td>07</td>
<td>15%</td>
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</table>

FIRST INTERNAL EXAM
### III
Fuzzy logic - fuzzy sets - properties - operations on fuzzy sets, fuzzy relations - operations on fuzzy relations

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<td>07</td>
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</table>

### IV
Fuzzy membership functions, fuzzification, Methods of membership value assignments – intuition – inference – rank ordering, Lambda – cuts for fuzzy sets, Defuzzification methods

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### SECOND INTERNAL EXAM

#### V

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<td>07</td>
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#### VI
Introduction to genetic algorithm, operators in genetic algorithm - coding - selection - cross over – mutation, Stopping condition for genetic algorithm flow, Genetic-neuro hybrid systems, Genetic-Fuzzy rule based system

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<td>07</td>
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</table>

### END SEMESTER EXAMINATION

**Question Paper Pattern**

1. There will be five parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering modules I and II; All four questions have to be answered.
3. Part B
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules I and II; Two questions have to be answered. Each question can have a maximum of three sub-parts
4. Part C
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering modules III and IV; All four questions have to be answered.
5. Part D
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three sub-parts
6. Part E
   a. Total Marks: 40
   b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions.
Course code | Course Name | L-T-P Credits | Year of Introduction
---|---|---|---
CS363 | Signals and Systems | 3-0-0-3 | 2016

Pre-requisite: NIL

Course Objectives

- To introduce fundamental concepts of continuous time and discrete time signals.
- To introduce fundamental concepts of continuous time and discrete time systems.
- To introduce frequency domain representation and analysis of signals.

Syllabus


Expected Outcome

The Students will be able to

i. Identify different types of continuous time and discrete time signals.
ii. Identify different types of continuous time and discrete time systems.
iii. Analyse signals using Z Transform and FT.
iv. Analyse signals using DFT and FFT.
v. Appreciate IIR digital filter structures.
vii. Appreciate FIR digital filter structures.

Text Books


References


Course Plan

<table>
<thead>
<tr>
<th>Module</th>
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<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>Signals and systems – introduction – basic operations on signals – continuous time and discrete time signals – step, impulse, ramp, exponential and sinusoidal functions.</td>
<td>07</td>
<td>15 %</td>
</tr>
<tr>
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</tr>
<tr>
<td>II</td>
<td>Continuous time and discrete time systems – properties of systems – linearity, causality, time invariance, memory, stability, invertibility. Linear time invariant systems – convolution.</td>
<td>07</td>
<td>15 %</td>
</tr>
<tr>
<td><strong>FIRST INTERNAL EXAM</strong></td>
<td>** SECOND INTERNAL EXAM**</td>
<td>** END SEMESTER EXAM**</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Discrete Fourier transform (DFT) - Properties of DFT – inverse DFT - Fast Fourier transform (FFT) - Radix-2 FFT algorithms – butterfly structure.</td>
<td>07</td>
<td>15 %</td>
</tr>
<tr>
<td>V</td>
<td>Digital filter structures – block diagram and signal flow graph representation – structures for IIR – direct form structure – Cascade form structure – parallel form structure – lattice structure.</td>
<td>07</td>
<td>20 %</td>
</tr>
<tr>
<td>VI</td>
<td>Structures for FIR – direct form structures – direct form structure of linear phase system – cascade form structure – frequency sampling structure – lattice structure.</td>
<td>07</td>
<td>20 %</td>
</tr>
</tbody>
</table>

**Question Paper Pattern**

1. There will be five parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules I and II; All *four* questions have to be answered.
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   b. *Three* questions each having 9 marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having 9 marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

There should be at least 60% analytical/numerical questions
Course code | Course Name | L-T-P-Credits | Year of Introduction |
---|---|---|---|
CS365 | OPTIMIZATION TECHNIQUES | 3-0-0-3 | 2016 |

Prerequisite: Nil

Course Objectives
- To build an understanding on the basics of optimization techniques.
- To introduce basics of linear programming and meta-heuristic search techniques.

Syllabus

Expected Outcome
The Students will be able to
i. Formulate mathematical models for optimization problems.
ii. Analyze the complexity of solutions to an optimization problem.
iii. Design programs using meta-heuristic search concepts to solve optimization problems.
iv. Develop hybrid models to solve an optimization problem.

Text Books

References

COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Decision-making procedure under certainty and under uncertainty - Operations Research-Probability and decision-making- Queuing or Waiting line theory-Simulation and Monte Carlo Technique- Nature and organization of optimization problems- Scope and hierarchy of optimization- Typical applications of optimization.</td>
<td>08</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Essential features of optimization problems - Objective function-Continuous functions - Discrete functions - Unimodal functions - Convex and concave functions, Investment costs and operating costs in objective function - Optimizing profitably constraints-Internal and external constraints-Formulation of optimization problems. Continuous functions - Discrete functions - Unimodal functions - Convex and concave functions.</td>
<td>07</td>
<td>15%</td>
</tr>
</tbody>
</table>
FIRST INTERNAL EXAM

| III | Necessary and sufficient conditions for optimum of unconstrained functions - Numerical methods for unconstrained functions - One-dimensional search - Gradient-free search with fixed step size. Linear Programming - Basic concepts of linear programming - Graphical interpretation - Simplex method - Apparent difficulties in the Simplex method. | 06 | 15% |

| IV | Transportation Problem, Loops in transportation table, Methods of finding initial basic feasible solution, Tests for optimality. Assignment Problem, Mathematical form of assignment problem, methods of solution. | 06 | 15% |

SECOND INTERNAL EXAM

| V | Network analysis by linear programming and shortest route, maximal flow problem. Introduction to Non-traditional optimization, Computational Complexity - NP-Hard, NP-Complete. Tabu Search - Basic Tabu search, Neighborhood, Candidate list, Short term and Long term memory | 07 | 20% |

| VI | Genetic Algorithms - Basic concepts, Encoding, Selection, Crossover, Mutation. Simulated Annealing - Acceptance probability, Cooling, Neighborhoods, Cost function. Application of GA and Simulated Annealing in solving sequencing and scheduling problems and Travelling salesman problem. | 08 | 20% |

END SEMESTER EXAM

**Question Paper Pattern**

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   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts.
6. Part E
   a. Total Marks: 40
   b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.
Course code | Course Name            | L-T-P - Credits | Year of Introduction |
-------------|------------------------|-----------------|----------------------|
CS367        | Logic for Computer Science | 3-0-0-3        | 2016                 |

Pre-requisites: CS205 Data Structures

**Course Objectives**

- To introduce the concepts of mathematical logic and its importance.
- To discuss propositional, predicate, temporal and modal logic and their applications.

**Syllabus**

Propositional Logic, Resolution, binary decision diagrams, Predicate logic, resolution, temporal logic, deduction, program verification, modal logic.

**Expected Outcome**

The students will be able to:

i. Gain the concept of logic and its importance.
ii. Understand fundamental concepts in propositional, predicate and temporal logic and apply resolution techniques.
iii. Apply the concept of program verification in real-world scenarios.
iv. Know the fundamental concepts in modal logic.

**Text Books**


**Reference**


**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introductory Concepts: Mathematical Logic, Propositional Logic, First Order Logic, Modal and Temporal logic, Program Verification. (Reading: Ben-Ari, Chapter 1) Propositional Logic: Formulae and interpretations, Equivalence, Satisfiability &amp; Validity, Semantic Tableaux, Soundness and Completeness. (Reading: Ben-Ari, Chapter 2 except 2.4, Additional Reading: Singh, Chapter 1)</td>
<td>06</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>The Hilbert Deductive System, Derived Rules, Theorems and operators, Soundness and Completeness, Consistency. (Reading: Ben-Ari, Chapter 3 except 3.7 and 3.8, Additional Reading: Singh, Chapter 1) Resolution in Propositional Logic: Conjunctive Normal form, Clausal form, resolution rule. (Reading: Ben-Ari, Chapter 4.1, 4.2, 4.3, Additional Reading: Singh, Chapter 1)</td>
<td>06</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>FIRST INTERNAL EXAM</td>
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<tr>
<td>III</td>
<td>Binary Decision Diagrams: Definition, Reduced and ordered BDD, Operators. (Reading: Ben-Ari, Chapter 5.1 – 5.5) Predicate Logic: Relations, predicates, formulae and interpretation, logical equivalence, semantic tableaux, soundness. (Reading: Ben-Ari, Chapter 7.1-7.6, Additional Reading: Singh, Chapter 2)</td>
<td>07</td>
<td>15%</td>
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</tbody>
</table>
The Hilbert deduction system for predicate logic. Functions, PCNF and clausal form, Herbrand model. Resolution in predicate logic: ground resolution, substitution, unification, general resolution. 

Reading: Ben-Ari, Chapter 8.1-8.4, 9.1, 9.3, 10.1-10.4, Additional Reading: Singh, Chapter 2, Chapter 3) 

SECOND INTERNAL EXAM 

Temporal logic: Syntax and semantics, models of time, linear time temporal logic, semantic tableaux. Deduction system of temporal logic. 

(Reading: Ben-Ari, Chapter 13.1-13.5, 14.1-14.2) 

VI

Program Verification: Need for verification, Framework for verification, Verification of sequential programs, deductive system, verification, synthesis. 

(Reading: Ben-Ari, Chapter 15.1-15.4, Additional Reading: Singh, Chapter 5) 

Modal Logic: Need for modal logic, Case Study: Syntax and Semantics of K, Axiomatic System KC, 

(Reading: Singh, Chapter 6.1-6.3) 

END SEMESTER EXAM

Assignments: Some of the assignments can be given on an interactive theorem prover like Isabelle or Coq.

Question Paper Pattern

1. There will be five parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering modules I and II; All four questions have to be answered.
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4. Part C
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   b. Four questions each having 3 marks, uniformly covering modules III and IV; All four questions have to be answered.
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   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
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   c. A question can have a maximum of three sub-parts.

There should be at least 60% analytical/numerical questions.
Course codes | Course Name | L-T-P - Credits | Year of Introduction
--- | --- | --- | ---
CS369 | Digital System Testing & Testable Design | 3-0-0-3 | 2016

Pre-requisites: CS234 Digital Systems Lab

Course Objectives
- To expose the students to the basics of digital testing techniques applied to VLSI circuits.
- To introduce the concepts of algorithm development for automatic test pattern generation for digital circuits.
- To discuss fundamentals of design for testability.

Syllabus
Basic terminology used in testing - functional and structural models of digital systems - logic simulation for design verification and testing - fault modeling - fault simulation - testing for faults - design for testability.

Expected Outcome
The students will be able to
- i. Appreciate the basics of VLSI testing and functions modeling of circuits.
- ii. Apply fault modeling using single stuck & multiple stuck modeling for combinational circuits.
- iii. Evaluate different methods for logic and fault simulations.
- iv. Generate test patterns using automatic test pattern generation methods like D, PODEM & FAN algorithms for combinational circuits.
- v. Explain automatic test pattern generation using time frame expansion and simulation based method for sequential circuits.
- vi. Design digital circuits using scan path and self tests.

Text Books

Reference

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
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<th>Hours</th>
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</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Fundamentals of Testing:</strong> Testing &amp; Diagnosis, testing at different levels of abstraction, errors &amp; faults, modeling &amp; evaluation, types of testing, test generation  <strong>Modeling:</strong> Functional modeling at logic level, functional modeling at register level &amp; structural models.</td>
<td>06</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Fault Modeling:</strong> Logic fault models, Fault detection and redundancy, Fault equivalence &amp; fault location, fault dominance, single stuck faults, multiple stuck fault models.</td>
<td>06</td>
<td>15%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAM
III | **Logic & fault Simulation:** Simulation for verification & test evaluation, types of simulation – compiled code & Event driven, serial fault simulation, statistical method for fault simulation. | 07 | 15% |

IV | **Combinational circuit test generation:** ATG for SSFs in combinational circuits – fault oriented ATG, fault independent ATG, random test generation, Sensitized path, D-algorithm, PODEM and FAN. | 07 | 15% |

**SECOND INTERNAL EXAM**

V | **Sequential circuit test generation:** ATPG for single clock synchronous circuits, time frame expansion method, simulation based sequential circuit ATPG – genetic algorithm. | 07 | 20% |

VI | **Design for Testability:** introduction to testability, design for testability techniques, controllability and observability by means of scan registers, generic scan based designs – scan path, boundary scan, Introduction to BIST. | 09 | 20% |

**END SEMESTER EXAM**

**Question Paper Pattern:**
1. There will be five parts in the question paper – A, B, C, D, E
2. **Part A**
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. **Part B**
   a. Total marks : 18
   b. *Three* questions each having 6 marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three sub-parts.
4. **Part C**
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. **Part D**
   a. Total marks : 18
   b. *Three* question each having 6 marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three sub-parts.
6. **Part E**
   a. Total Marks: 40
   1. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   2. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions.
Course code | Course Name | L-T-P - Credits | Year of Introduction
--- | --- | --- | ---
CS302 | Design and Analysis of Algorithms | 3-1-0-4 | 2016

Prerequisite: Nil

Course Objectives
- To introduce the concepts of Algorithm Analysis, Time Complexity, Space Complexity.
- To discuss various Algorithm Design Strategies with proper illustrative examples.
- To introduce Complexity Theory.

Syllabus
Introduction to Algorithm Analysis, Notions of Time and Space Complexity, Asymptotic Notations, Recurrence Equations and their solutions, Master’s Theorem, Divide and Conquer and illustrative examples, AVL trees, Red-Black Trees, Union-find algorithms, Graph algorithms, Divide and Conquer, Dynamic Programming, Greedy Strategy, Back Tracking and Branch and Bound, Complexity classes

Expected outcome
The students will be able to
i. Analyze a given algorithm and express its time and space complexities in asymptotic notations.
ii. Solve recurrence equations using Iteration Method, Recurrence Tree Method and Master’s Theorem.
iii. Design algorithms using Divide and Conquer Strategy.
vi. Design efficient algorithms using Back Tracking and Branch Bound Techniques for solving problems.

Text Books

References

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
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</thead>
</table>


<table>
<thead>
<tr>
<th>I</th>
<th><strong>Introduction to Algorithm Analysis:</strong> Time and Space Complexity-Elementary operations and Computation of Time Complexity-Best, worst and Average Case Complexities- Complexity Calculation of simple algorithms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Recurrence Equations:</strong> Solution of Recurrence Equations – Iteration Method and Recursion Tree Methods</td>
</tr>
<tr>
<td></td>
<td><strong>Master’s Theorem:</strong> (Proof not required) – examples, Asymptotic Notations and their properties- Application of Asymptotic Notations in Algorithm Analysis- Common Complexity Functions</td>
</tr>
<tr>
<td></td>
<td><strong>AVL Trees</strong> – rotations, Red-Black Trees insertion and deletion (Techniques only; algorithms not expected). <strong>B-Trees</strong> – insertion and deletion operations. <strong>Sets</strong>- Union and find operations on disjoint sets.</td>
</tr>
<tr>
<td></td>
<td><strong>Graphs</strong> – DFS and BFS traversals, complexity. <strong>Spanning trees</strong> – Minimum Cost Spanning Trees, single source shortest path algorithms, Topological sorting, strongly connected components.</td>
</tr>
<tr>
<td></td>
<td><strong>Divide and Conquer:</strong> The Control Abstraction, 2 way Merge sort, Strassen’s Matrix Multiplication, Analysis</td>
</tr>
<tr>
<td></td>
<td><strong>Dynamic Programming:</strong> The control Abstraction- The Optimality Principle- Optimal matrix multiplication, Bellman-Ford Algorithm</td>
</tr>
<tr>
<td></td>
<td><strong>Analysis,</strong> Comparison of Divide and Conquer and Dynamic Programming strategies</td>
</tr>
<tr>
<td></td>
<td><strong>Greedy Strategy:</strong> - The Control Abstraction- the Fractional Knapsack Problem, Minimal Cost Spanning Tree Computation- Prim’s Algorithm – Kruskal’s Algorithm.</td>
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<td></td>
<td><strong>Back Tracking:</strong> -The Control Abstraction – The N Queen’s Problem, 0/1 Knapsack Problem</td>
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<td></td>
<td><strong>Branch and Bound:</strong> Travelling Salesman Problem.</td>
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<tr>
<td></td>
<td><strong>Introduction to Complexity Theory</strong> : - Tractable and Intractable Problems- The P and NP Classes- Polynomial Time Reductions - The NP- Hard and NP-Complete Classes</td>
</tr>
<tr>
<td>I</td>
<td><strong>FIRST INTERNAL EXAM</strong></td>
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<tr>
<td></td>
<td><strong>Part A</strong></td>
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<tr>
<td></td>
<td><strong>Total marks : 12</strong></td>
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<td></td>
<td><strong>Four</strong> questions each having <strong>3</strong> marks, uniformly covering modules I and II; <strong>All four</strong> questions have to be answered.</td>
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<tr>
<td></td>
<td><strong>Part B</strong></td>
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<tr>
<td></td>
<td><strong>Total marks : 18</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Three</strong> questions each having <strong>9</strong> marks, uniformly covering modules I and II; <strong>Two</strong> questions have to be answered. Each question can have a maximum of three subparts.</td>
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<tr>
<td></td>
<td><strong>Part C</strong></td>
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<tr>
<td></td>
<td><strong>SECOND INTERNAL EXAM</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Total marks : 18</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Three</strong> questions each having <strong>9</strong> marks, uniformly covering modules I and II; <strong>Two</strong> questions have to be answered. Each question can have a maximum of three subparts.</td>
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<td><strong>END SEMESTER EXAM</strong></td>
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<tr>
<td></td>
<td><strong>Total marks : 22</strong></td>
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<tr>
<td></td>
<td><strong>Four</strong> questions each having <strong>5.5</strong> marks, uniformly covering modules I and II; <strong>Three</strong> questions have to be answered. Each question can have a maximum of three subparts.</td>
</tr>
</tbody>
</table>

**Question Paper Pattern**

1. There will be five parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. **Four** questions each having **3** marks, uniformly covering modules I and II; **All four** questions have to be answered.
3. Part B
   a. Total marks : 18
   b. **Three** questions each having **9** marks, uniformly covering modules I and II; **Two** questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
a. Total marks : 12
b. Four questions each having 3 marks, uniformly covering modules III and IV; All four questions have to be answered.

5. Part D
a. Total marks : 18
b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts

6. Part E
a. Total Marks: 40
b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.


<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS304</td>
<td>COMPILER DESIGN</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**
- To provide a thorough understanding of the internals of Compiler Design.

**Syllabus**

**Expected Outcome**
The students will be able to:

1. Explain the concepts and different phases of compilation with compile time error handling.
2. Represent language tokens using regular expressions, context free grammar and finite automata and design lexical analyzer for a language.
3. Compare top down with bottom up parsers, and develop appropriate parser to produce parse tree representation of the input.
4. Generate intermediate code for statements in high level language.
5. Design syntax directed translation schemes for a given context free grammar.
6. Apply optimization techniques to intermediate code and generate machine code for high level language program.

**Text Books**

**References**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to compilers – Analysis of the source program, Phases of a compiler, Grouping of phases, compiler writing tools – bootstrapping <strong>Lexical Analysis:</strong> The role of Lexical Analyzer, Input Buffering, Specification of Tokens using Regular Expressions, Review of Finite Automata, Recognition of Tokens.</td>
<td>07</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Syntax Analysis:</strong> Review of Context-Free Grammars – Derivation trees and Parse Trees, Ambiguity. <strong>Top-Down Parsing:</strong> Recursive Descent parsing, Predictive parsing, LL(1) Grammars.</td>
<td>06</td>
<td>15%</td>
</tr>
</tbody>
</table>
## FIRST INTERNAL EXAM

<table>
<thead>
<tr>
<th>III</th>
<th>Bottom-Up Parsing:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shift Reduce parsing – Operator precedence parsing (Concepts only)</td>
</tr>
<tr>
<td></td>
<td>LR parsing – Constructing SLR parsing tables, Constructing, Canonical LR parsing tables and Constructing LALR parsing tables.</td>
</tr>
</tbody>
</table>

|     | 07 | 15% |

<table>
<thead>
<tr>
<th>IV</th>
<th>Syntax directed translation:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Syntax directed definitions, Bottom-up evaluation of S-attributed definitions, L-attributed definitions, Top-down translation, Bottom-up evaluation of inherited attributes.</td>
</tr>
<tr>
<td></td>
<td>Type Checking:</td>
</tr>
<tr>
<td></td>
<td>Type systems. Specification of a simple type checker.</td>
</tr>
</tbody>
</table>

|     | 08 | 15% |

## SECOND INTERNAL EXAM

<table>
<thead>
<tr>
<th>V</th>
<th>Run-Time Environments:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Source Language issues, Storage organization, Storage-allocation strategies.</td>
</tr>
<tr>
<td></td>
<td>Intermediate Code Generation (ICG):</td>
</tr>
<tr>
<td></td>
<td>Intermediate languages – Graphical representations, Three-Address code, Quadruples, Triples. Assignment statements, Boolean expressions.</td>
</tr>
</tbody>
</table>

|     | 07 | 20% |

## END SEMESTER EXAM

### Question Paper Pattern

1. There will be five parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering modules I and II; All four questions have to be answered.
3. Part B
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules I and II; Two questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering modules III and IV; All four questions have to be answered.
5. Part D
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.
Course Code | Course Name | L-T-P - Credits | Year of Introduction
---|---|---|---
CS306 | Computer Networks | 3-0-0-3 | 2016

Prerequisite: Nil

Course Objectives
- To build an understanding of the fundamental concepts of computer networking.
- To introduce the basic taxonomy and terminology of computer networking.
- To introduce advanced networking concepts.

Syllabus
- Concept of layering, LAN technologies (Ethernet), Flow and error control techniques, switching, IPv4/IPv6, routers and routing algorithms (distance vector, link state), TCP/UDP and sockets, congestion control, Application layer protocols.

Expected Outcome
The students will be able to
- Visualise the different aspects of networks, protocols and network design models.
- Examine various Data Link layer design issues and Data Link protocols.
- Analyse and compare different LAN protocols.
- Compare and select appropriate routing algorithms for a network.
- Examine the important aspects and functions of network layer, transport layer and application layer in internetworking.

Text Books
1. Andrew S. Tanenbaum, Computer Networks, 4/e, PHI.
2. Behrouz A. Forouzan, Data Communications and Networking, 4/e, Tata McGraw Hill.

References
1. Fred Halsall, Computer Networking and the Internet, 5/e.

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
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<th>Hours</th>
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</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Data Link layer Design Issues – Flow Control and ARQ techniques. Data link Protocols – HDLC. DLL in Internet. MAC Sub layer – IEEE 802 FOR LANs &amp; MANs, IEEE 802.3, 802.4, 802.5. Bridges - Switches – High Speed LANs - Gigabit Ethernet. Wireless LANs - 802.11 a/b/g/n, 802.15.PPP</td>
<td>08</td>
<td>15%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAMINATION
III  | Network layer – Routing – Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, RIP, OSPF, Routing for mobile hosts. | 07 | 15%

IV  | Congestion control algorithms – QoS. Internetworking – Network layer in internet. IPv4 - IP Addressing – Classless and Classfull Addressing. Sub-netting. | 07 | 15%

SECOND INTERNAL EXAMINATION


VI  | Transport Layer – TCP & UDP. Application layer –FTP, DNS, Electronic mail, MIME, SNMP. Introduction to World Wide Web. | 07 | 20%

END SEMESTER EXAM

Question Paper Pattern

1. There will be five parts in the question paper – A, B, C, D, E
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   a. Total marks : 12
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5. Part D
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6. Part E
   a. Total Marks: 40
   b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.
## Course Overview

**Course Code:** CS308  
**Course Name:** Software Engineering and Project Management  
**Credits:** 3-0-0-3  
**Year of Introduction:** 2016

### Pre-requisite:
Nil

### Course Objectives
- To introduce the fundamental concepts of software engineering.
- To build an understanding on various phases of software development.
- To introduce various software process models.

### Syllabus
Introduction to software engineering, Software process models, Software development phases, Requirement analysis, Planning, Design, Coding, Testing, Maintenance.

### Expected Outcome
The students will be able to
- i. Identify suitable life cycle models to be used.
- ii. Analyze a problem and identify and define the computing requirements to the problem.
- iii. Translate a requirement specification to a design using an appropriate software engineering methodology.
- iv. Formulate appropriate testing strategy for the given software system.
- v. Develop software projects based on current technology, by managing resources economically and keeping ethical values.

### References

### Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
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</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to software engineering- scope of software</td>
<td>07</td>
<td>15%</td>
</tr>
</tbody>
</table>
engineering - historical aspects, economic aspects, maintenance aspects, specification and design aspects, team programming aspects. Software engineering a layered technology – processes, methods and tools. Software process models - prototyping models, incremental models, spiral model, waterfall model.

**II**


**FIRST INTERNAL EXAM**

**III**

Planning phase – project planning objective, software scope, empirical estimation models- COCOMO, single variable model, staffing and personal planning. Design phase – design process, principles, concepts, effective modular design, top down, bottom up strategies, stepwise refinement.

**IV**

Coding – programming practice, verification, size measures, complexity analysis, coding standards. Testing – fundamentals, white box testing, control structure testing, black box testing, basis path testing, code walk-throughs and inspection, testing strategies-Issues, Unit testing, integration testing, Validation testing, System testing.

**SECOND INTERNAL EXAM**

**V**


**VI**

Project scheduling and tracking: Basic concepts-relation between people and effort-defining task set for the software project-selecting software engineering task

**END SEMESTER EXAM**

**Question Paper Pattern**

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules I and II;
All four questions have to be answered.

3. Part B
   a. Total marks : 18
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   b. Four questions each having 3 marks, uniformly covering modules III and IV; All four questions have to be answered.

5. Part D
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts

6. Part E
   a. Total Marks: 40
   b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.
### Course Objectives

- To develop ability to critically analyse and evaluate a variety of management practices in the contemporary context;
- To understand and apply a variety of management and organisational theories in practice;
- To be able to mirror existing practices or to generate their own innovative management competencies, required for today's complex and global workplace;
- To be able to critically reflect on ethical theories and social responsibility ideologies to create sustainable organisations.

### Syllabus

Definition, roles and functions of a manager, management and its science and art perspectives, management challenges and the concepts like, competitive advantage, entrepreneurship and innovation. Early contributors and their contributions to the field of management. Corporate Social Responsibility. Planning, Organizing, Staffing and HRD functions, Leading and Controlling. Decision making under certainty, uncertainty and risk, creative process and innovation involved in decision making.

### Expected outcome.

A student who has undergone this course would be able to

1. manage people and organisations
2. critically analyse and evaluate management theories and practices
3. plan and make decisions for organisations
4. do staffing and related HRD functions

### Text Book:


### References:


### Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
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</tr>
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<tbody>
<tr>
<td>I</td>
<td>Introduction to Management: definitions, managerial roles and functions; Science or Art perspectives- External environment- global, innovative and entrepreneurial perspectives of Management (3 Hrs.)– Managing people and organizations in the context of New Era- Managing for competitive advantage - the Challenges of Management (3 Hrs.)</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Early Contributions and Ethics in Management: Scientific Management- contributions of Taylor, Gilbreths, Human Relations approach-contributions of Mayo, McGregor's Theory, Ouchi's Theory Z (3 Hrs.) Systems Approach, the Contingency Approach, the Mckinsey 7-S Framework Corporate Social responsibility- Managerial Ethics. (3 Hrs)</td>
<td>6</td>
<td>15%</td>
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**FIRST INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>III</th>
<th>Planning: Nature and importance of planning, -types of plans (3 Hrs.)- Steps in planning, Levels of planning - The Planning Process. – MBO (3 Hrs.).</th>
<th>6</th>
<th>15%</th>
</tr>
</thead>
</table>

| IV | Organising for decision making: Nature of organizing, organization levels and span of control in management Organisational design and structure –departmentation, line and staff concepts (3 Hrs.) Limitations of decision making- Evaluation and selecting from alternatives- programmed and non programmed decisions - decision under certainty, uncertainty and risk-creative process and innovation (3 Hrs.) | 6 | 15% |

**SECOND INTERNAL EXAMINATION**

| V | Staffing and related HRD Functions: definition, Empowerment, staff – delegation, decentralization and centralisation of authority – Effective Organizing and culture-responsive organizations –Global and entrepreneurial organizing (3 Hrs.) Manager inventory chart-matching person with the job-system approach to selection (3 Hrs.) Job design-skills and personal characteristics needed in managers- selection process, techniques and instruments (3 Hrs.) | 9 | 20% |

| VI | Leading and Controlling: Leading Vs Managing – Trait approach and Contingency approaches to leadership - Dimensions of Leadership (3 Hrs.) - Leadership Behavior and styles – Transactional and Transformational Leadership (3 Hrs.) Basic control process- control as a feedback system – Feed Forward Control – Requirements for effective control – control techniques – Overall controls and preventive controls – Global controlling (3 Hrs.) | 9 | 20% |

**END SEMESTER EXAM**

**Question Paper Pattern**

Max. marks: 100, Time: 3 hours.
The question paper shall consist of three parts

**Part A:** 4 questions uniformly covering modules I and II. Each question carries 10 marks Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B:** 4 questions uniformly covering modules III and IV. Each question carries 10 marks Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C:** 6 questions uniformly covering modules V and VI. Each question carries 10 marks Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note:** In all parts, each question can have a maximum of four sub questions, if needed.
Course code | Course Name | L-T-P-Credits | Year of Introduction
--- | --- | --- | ---
CS332 | MICROPROCESSOR LAB | 0-0-3-1 | 2016

Pre-requisite: CS305 Microprocessors and Microcontrollers

Course Objectives
- To practice assembly language programming on 8086.
- To practice fundamentals of interfacing/programming various peripheral devices with microprocessor/microcontroller.

List of Exercises/Experiments: (Minimum 12 Exercises/Experiments are mandatory. Exercises/Experiments marked with * are mandatory)

I. Assembly Language Programming Exercises/Experiments using 8086 Trainer kit

1. Implementation of simple decimal arithmetic and bit manipulation operations.*
2. Implementation of code conversion between BCD, Binary, Hexadecimal and ASCII.
3. Implementation of searching and sorting of 16-bit numbers.
4. Programming exercises using stack and subroutines.*

II. Exercises/Experiments using MASM (PC Required)

5. Study of Assembler and Debugging commands.
6. Implementation of decimal arithmetic(16 and 32 bit) operations.*
7. Implementation of String manipulations.*
8. Implementation of searching and sorting of 16-bit numbers.
9. Implementation of Matrix operations like addition, transpose, multiplication etc.

III. Interfacing Exercises/Experiments with 8086 trainer kit through Assembly Language Programming

10. Interfacing with stepper motor - Rotate through any given sequence.*
11. Interfacing with 8255 (mode0 and mode1 only).*
12. Interfacing with 8279 (Rolling message, 2 key lock out and N-key roll over implementation).*
13. Interfacing with 8253/54 Timer/Counter.
15. Interfacing with Analog-to-Digital Converter.
16. Interfacing with 8259 Interrupt Controller.

IV. Exercises/Experiments using 8051 trainer kit

17. Familiarization of 8051 trainer kit by executing simple Assembly Language programs such as decimal arithmetic and bit manipulation.*
18. Implementation of Timer programming (in mode1).
19. Implementation of stepper motor interfacing, ADC/DAC interfacing and sensor interfacing with 8251 through Assembly Language programming.

Expected Outcome
The students will be able to

i. Develop assembly language programs for problem solving using software interrupts and various assembler directives.

ii. Implement interfacing of various I/O devices to the microprocessor/microcontroller through assembly language programming.
Course code | Course Name | L-T-P-Credits | Year of Introduction
---|---|---|---
CS334 | Network Programming Lab | 0-0-3-1 | 2016

**Pre-requisite: CS307 Data Communication**

**Course Objectives**

- To introduce Network related commands and configuration files in Linux Operating System.
- To introduce tools for Network Traffic Analysis and Network Monitoring.
- To practice Network Programming using Linux System Calls.
- To design and deploy Computer Networks.

**List of Exercises/ Experiments (12 Exercises/ Experiments are to be completed . Exercises/ Experiments marked with * are mandatory)**

1. Getting started with Basics of Network configurations files and Networking Commands in Linux.
2. To familiarize and understand the use and functioning of System Calls used for Operating system and network programming in Linux.
3. Familiarization and implementation of programs related to Process and thread.
4. Implement the First Readers-Writers Problem.
5. Implement the Second Readers-Writers problem.
6. Implement programs for Inter Process Communication using PIPE, Message Queue and Shared Memory.
7. Implement Client-Server communication using Socket Programming and TCP as transport layer protocol.*
8. Implement Client-Server communication using Socket Programming and UDP as transport layer protocol.*
9. Implement a multi user chat server using TCP as transport layer protocol.*
10. Implement Concurrent Time Server application using UDP to execute the program at remoteserver. Client sends a time request to the server, server sends its system time back to the client. Client displays the result.*
11. Implement and simulate algorithm for Distance vector routing protocol.
12. Implement and simulate algorithm for Link state routing protocol.
13. Implement Simple Mail Transfer Protocol.*
14. Develop concurrent file server which will provide the file requested by client if it exists. If not server sends appropriate message to the client. Server should also send its process ID (PID) to clients for display along with file or the message.*
15. Using Wireshark observe data transferred in client server communication using UDP and identify the UDP datagram.
16. Using Wireshark observe Three Way Handshaking Connection Establishment, Data Transfer and Three Way Handshaking Connection Termination in client server communication using TCP.
17. Develop a packet capturing and filtering application using raw sockets.
18. Design and configure a network with multiple subnets with wired and wireless LANs using required network devices. Configure the following services in the network- TELNET, SSH, FTP server, Web server, File server, DHCP server and DNS server.*
19. Install network simulator NS-2 in any of the Linux operating system and simulate wired and wireless scenarios.

**Expected Outcome**

The students will be able to

1. Use network related commands and configuration files in Linux Operating System.
2. Develop operating system and network application programs.
3. Analyze network traffic using network monitoring tools.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>352</strong></td>
<td>Comprehensive Examination</td>
<td>0-1-1-2</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite : Nil

**Course Objectives**
- To assess the comprehensive knowledge gained in basic courses relevant to the branch of study
- To comprehend the questions asked and answer them with confidence.

**Assessment**

**Oral examination** – To be conducted by the college (@ three students/hour) covering all the courses up to and including V semester – 50 marks

**Written examination** - To be conducted by the Dept. on the date announced by the University – common to all students of the same branch – objective type (1 hour duration) – 50 multiple choice questions (4 choices) of 1 mark each covering the six common courses of S1&S2 and six branch specific courses listed – questions are set by the University - no negative marks – 50 marks.

*Note: Both oral and written examinations are mandatory. But separate minimum marks is not insisted for pass. If a students does not complete any of the two assessments, grade I shall be awarded and the final grade shall be given only after the completion of both the assessments. The two hours allotted for the course may be used by the students for discussion, practice and for oral assessment.

**Expected outcome.**
- The students will be confident in discussing the fundamental aspects of any engineering problem/situation and give answers in dealing with them
Course code | Course Name | L-T-P-Credits | Year of Introduction
---|---|---|---
CS362 | Computer Vision | 3-0-0-3 | 2016

Pre-requisite: NIL

**Course Objectives**
- To build an understanding on detailed models of image formation.
- To expose the students to image feature detection and matching.
- To introduce fundamental algorithms for pattern recognition.
- To introduce various classification techniques.
- To expose the students to various structural pattern recognition and feature extraction techniques.

**Syllabus**
Image formation and Image model with Components of a vision system, Multiple images and the Geometry of multiple views, High level vision, Basics of pattern recognition, Linear discriminant based classifiers and tree classifiers, Unsupervised Methods, Recent Advances in Pattern Recognition.

**Expected Outcome**
The students will be able to
i. Appreciate the detailed models of image formation.
ii. Analyse the techniques for image feature detection and matching.
iii. Apply various algorithms for pattern recognition.
iv. Examine various clustering algorithms.
v. Analyze structural pattern recognition and feature extraction techniques.

**Text Books:**

**References**

**COURSE PLAN**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
</table>

| I | Image formation and Image model- Components of a vision system- Cameras- camera model and camera calibration- Radiometry- Light in space- Light in surface - Sources, shadows and shading. | 06 | 15% |
| II | Multiple images-The Geometry of multiple views- Stereopsis- Affine structure from motion- Elements of Affine Geometry Affine structure and motion from two images- Affine structure and motion from multiple images- From Affine to Euclidean images. | 07 | 15% |
| III | High level vision- Geometric methods- Model based vision- Obtaining hypothesis by pose consistency, pose clustering and using Invariants, Verification. | 07 | 15% |
| IV | Introduction to pattern and classification, supervised and unsupervised learning, Clustering Vs classification, Bayesian Decision Theory- Minimum error rate classification Classifiers, discriminant functions, decision surfaces- The normal density and discriminant-functions for the Normal density. | 07 | 15% |
| V | Linear discriminant based classifiers and tree classifiers Linear discriminant function based classifiers- Perceptron- Minimum Mean Squared Error (MME) method, Support Vector machine, Decision Trees; CART, ID3. | 07 | 20% |
| VI | Unsupervised Methods Basics of Clustering; similarity / dissimilarity measures; clustering criteria. Different distance functions and similarity measures, K-means algorithm. Recent Advances in Pattern Recognition Neural network structures for pattern recognition, Pattern classification using Genetic Algorithms. | 08 | 20% |

**Question Paper Pattern**

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules I and II; *All four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having 9 marks, uniformly covering modules I and II;
Two questions have to be answered. Each question can have a maximum of three subparts.

4. Part C
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering modules III and IV; All four questions have to be answered.

5. Part D
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts

6. Part E
   a. Total Marks: 40
   b. Six questions each carrying 10 marks, uniformly covering modules V and VI; Four questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.
Course code | Course Name | L-T-P - Credits | Year of Introduction
---|---|---|---
CS364 | Mobile Computing | 3-0-0-3 | 2016

Pre-requisite: CS307 Data Communication

Course Objectives
- To impart basic understanding of the wireless communication systems.
- To expose students to various aspects of mobile and ad-hoc networks.

Syllabus

Expected Outcome
Student is able to
1. Explain various Mobile Computing application, services and architecture.
2. Understand various technology trends for next generation cellular wireless networks.
3. Describe protocol architecture of WLAN technology.

Text Books

References

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to mobile computing, Middleware and Gateways, Application and services, Internet-Ubiquitous networks, Architecture and three-tier architecture for Mobile Computing, Design consideration for Mobile Computing.</td>
<td>06</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Spread spectrum – Direct sequence, Frequency hoping, Medium Access Control - SDMA, FDMA, TDMA, CDMA, Cellular concepts- channel assignment strategy- hand off strategy interface and system capacity- improving coverage and capacity in cellular system, Satellite Systems-GEO, LEO, MEO. Wireless Communication Systems- Telecommunication Systems- GSM-GSM services &amp; features, architecture -DECT features &amp; characteristics, architecture.</td>
<td>06</td>
<td>15%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAM
<table>
<thead>
<tr>
<th>IV</th>
<th>Mobile internet-mobile network layer-mobile IP-dynamic host configuration protocol-, mobile transport layer-implications of TCP on mobility-indirect TCP-snooping TCP- mobile TCP transmission-selective retransmission, Transaction oriented TCP- Support for mobility-file systems-WAP.</th>
</tr>
</thead>
<tbody>
<tr>
<td>07</td>
<td>15%</td>
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</tbody>
</table>

**SECOND INTERNAL EXAM**

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<tr>
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<tbody>
<tr>
<td>08</td>
<td>20%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VI</th>
<th>Security issues in mobile computing, Information Security, Components of Information Security, Next Generation Networks-LTE – Architecture &amp; Interface – LTE radio planning and tools, 5G architecture, MIMO, Super core concept, Features and Application Case Study – Setting up an adhoc network system, LiFi.</th>
</tr>
</thead>
<tbody>
<tr>
<td>08</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**Question Paper Pattern**

1. There will be five parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering modules I and II; All four questions have to be answered.
3. Part B
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules I and II; Two questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering modules III and IV; All four questions have to be answered.
5. Part D
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
   c. A question can have a maximum of three sub-parts.
**Course code** | **Course Name** | **L-T-P Credits** | **Year of Introduction**
--- | --- | --- | ---
CS366 | Natural language processing | 3-0-0-3 | 2016

**Prerequisite:** Nil

**Course Objectives**
- To introduce the fundamentals of Language processing from the algorithmic viewpoint.
- To discuss various issues those make natural language processing a hard task.
- To discuss some applications of Natural Language Processing (NLP).

**Syllabus**
Levels of Language Analysis, Syntax, Semantics and Pragmatics of Natural Language, Language Processing. Issues and approaches to solutions, Applications of Natural Language Processing (NLP).

**Expected Outcome**
The student able to
1. appreciate the fundamental concepts of Natural Language Processing.
2. design algorithms for NLP tasks.
3. develop useful systems for language processing and related tasks involving text processing.

**Text Books**

**References**
1. Charniak, Eugene, Introduction to Artificial intelligence, Addison-Wesley, 1985..

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to Natural Language Understanding- Levels of language analysis- Syntax, Semantics, Pragmatics. Linguistic Background- An Outline of English Syntax.</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Lexicons, POS Tagging, Word Senses. Grammars and Parsing- Features, Agreement and Augmented Grammars.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>FIRST INTERNAL EXAM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Semantics and Logical Form: Linking Syntax and Semantics-Ambiguity Resolution- other Strategies for Semantic Interpretation- Scoping and the Interpretation of Noun Phrases.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>SECOND INTERNAL EXAM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Knowledge Representation and Reasoning- Local Discourse</td>
<td>8</td>
<td>20%</td>
</tr>
</tbody>
</table>
Question Paper Pattern

1. There will be five parts in the question paper – A, B, C, D, E.

2. Part A
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering modules I and II; All four questions have to be answered.

3. Part B
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules I and II; Two questions have to be answered. Each question can have a maximum of three subparts.

4. Part C
   a. Total marks : 12
   b. Four questions each having 3 marks, uniformly covering modules III and IV; All four questions have to be answered.

5. Part D
   a. Total marks : 18
   b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts.

6. Part E
   a. Total Marks: 40
   b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
   c. A question can have a maximum of three sub-parts.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS368</td>
<td>Web Technologies</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**
- To impart the design, development and implementation of Dynamic Web Pages.
- To develop programs for Web using Scripting Languages.
- To give an introduction to Data Interchange formats in Web.

**Syllabus**
Basics of Internet and World Wide Web, HTML and XHTML, Cascading Style Sheets, Frameworks, Basics of JavaScript, JQuery, Introduction to XML and JSON, Overview of PHP

**Expected Outcome**
The student will be able to
- Understand different components in web technology and to know about CGI and CMS.
- Develop interactive Web pages using HTML/XHTML.
- Present a professional document using Cascaded Style Sheets.
- Construct websites for user interactions using JavaScript and JQuery.
- Know the different information interchange formats like XML and JSON.
- Develop Web applications using PHP.

**Text Books**

**References**
4. Dream Tech, Web Technologies: HTML, JS, PHP, Java, JSP, ASP.NET, XML, AJAX,

**Web Resources**
1. www.w3.org/CGI/
2. old.tree.ro/en/strategy-white-papers/content-management-systems.pdf
3. httpd.apache.org/download.cgi
6. https://www.w3.org/TR/WD-DOM/introduction.html

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End</th>
<th>Exam</th>
<th>Marks</th>
</tr>
</thead>
</table>

Prerequisite: Nil
Case Study: Apache Server, WordPress. | 06 | 15% |
<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>II</td>
<td>Introduction to HTML/XHTML: Origins and Evolution of HTML and XHTML, Basic Syntax of HTML, Standard HTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, HTML5, Syntactic Differences between HTML and XHTML.</td>
<td>07</td>
<td>15%</td>
</tr>
</tbody>
</table>
| III | Introduction to Styles sheets and Frameworks  
**Cascading Style Sheets:** Levels of Style Sheets - Style Specification Formats, Selector Forms, Property-Value Forms, Font Properties, List Properties, Alignment of Text, Color, The Box Model, Background Images, The span and div Tags.  
**Frameworks:** Overview and Basics of Responsive CSS Frameworks - Bootstrap. | 06 | 15% |
| IV | Introduction to JavaScript and jQuery  
**The Basics of JavaScript:** Overview of JavaScript, Object Orientation and JavaScript, General Syntactic Characteristics-Primitives, Operations, and Expressions, Screen Output and Keyboard Input, Control Statements, Object Creation and Modification, Arrays, Functions, Callback Functions, JavaScript HTML DOM.  
**Introduction to jQuery:** Overview and Basics. | 07 | 15% |
| V | Introduction to Data Interchange Formats  
**JSON (Basics Only):** Overview, Syntax, Datatypes, Objects, Schema, Comparison with XML. | 08 | 20% |
| VI | Introduction to PHP: Origins and Uses of PHP, Overview of PHP - General Syntactic Characteristics - Primitives, Operations, and Expressions - Control Statements, Arrays, Functions, Pattern Matching, Form Handling, Cookies, Session Tracking. | 08 | 20% |
| Assignment:  
It is highly recommended to give assignment based on:  
1. JavaScript Frameworks (like AngularJS or/and NodeJS)  
2. Any PHP web app based on frameworks (like Laravel, CodeIgniter, CakePHP, Zend etc.) | --- | --- | --- |
**Question Paper Pattern**

1. There will be five parts in the question paper – A, B, C, D, E

2. Part A
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules I and II; All *four* questions have to be answered.

3. Part B
   a. Total marks : 18
   b. *Three* questions each having 2 marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.

4. Part C
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All *four* questions have to be answered.

5. Part D
   a. Total marks : 18
   b. *Three* questions each having 2 marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts

6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
Course code. | Course Name               | L-T-P - Credits | Year of Introduction |
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>CS372</td>
<td>HIGH PERFORMANCE COMPUTING</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Pre-requisites:** CS202 Computer Organization and Architecture

**Course Objectives**
- To introduce the concepts of Modern Processors.
- To introduce Optimization techniques for serial code.
- To introduce Parallel Computing Paradigms.
- To introduce Parallel Programming using OpenMP and MPI.

**Syllabus**

**Expected Outcome**
The students will be able to
1. appreciate the concepts used in Modern Processors for increasing the performance.
2. appreciate Optimization techniques for serial code.
3. appreciate Parallel Computing Paradigms.
4. identify the performance issues in Parallel Programming using OpenMP and MPI.

**Text Book**

**References**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
</table>
### II

07 15%

### FIRST INTERNAL EXAM

07 15%

Distributed memory parallel programming with MPI: message passing - introduction to MPI – example - messages and point-to-point communication - collective communication – nonblocking point-to-point communication- virtual topologies - MPI parallelization of Jacobi solver- MPI implementation - performance properties

08 15%

### SECOND INTERNAL EXAM

08 20%

Efficient MPI programming : MPI performance tools- communication parameters- Synchronization, serialization, contention- Reducing communication overhead- optimal domain decomposition- Aggregating messages – Nonblocking Vs Asynchronous communication- Collective communication- Understanding intra-node point-to-point communication.

08 20%

### END SEMESTER EXAM

Question Paper Pattern
1. There will be five parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
b. *Four* questions each having 3 marks, uniformly covering modules I and II; *All four* questions have to be answered.

3. Part B  
   a. Total marks : 18  
   b. *Three* questions each having 9 marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.

4. Part C  
   a. Total marks : 12  
   b. *Four* questions each having 3 marks, uniformly covering modules III and IV; *All four* questions have to be answered.

5. Part D  
   a. Total marks : 18  
   b. *Three* questions each having 9 marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts.

6. Part E  
   a. Total Marks: 40  
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.  
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS401</td>
<td>COMPUTER GRAPHICS</td>
<td>4-0-0-4</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives:**
- To introduce concepts of graphics input and display devices.
- To discuss line and circle drawing algorithms.
- To introduce 2D and 3D transformations and projections.
- To introduce fundamentals of image processing.

**Syllabus:**

**Expected Outcome:**
The Students will be able to:
- i. compare various graphics devices
- ii. analyze and implement algorithms for line drawing, circle drawing and polygon filling
- iii. apply geometrical transformation on 2D and 3D objects
- iv. analyze and implement algorithms for clipping
- v. apply various projection techniques on 3D objects
- vi. summarize visible surface detection methods
- vii. interpret various concepts and basic operations of image processing

**Text Books:**
2. E. Gose, R. Johnsonbaugh and S. Jost., Pattern Recognition and Image Analysis, PHI PTR, 1996 (Module VI – Image Processing part)

**References:**
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Basic concepts in Computer Graphics – Types of Graphic Devices – Interactive Graphic inputs – Raster Scan and Random Scan Displays.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Line Drawing Algorithm- DDA, Bresenham’s algorithm – Circle Generation Algorithms – Mid point circle algorithm, Bresenham’s algorithm- Scan Conversion-frame buffers – solid area scan conversion – polygon filling algorithms</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Two dimensional transformations. Homogeneous coordinate systems – matrix formulation and concatenation of transformations. Windowing concepts – Window to Viewport Transformation- Two dimensional clipping-Line clipping – Cohen Sutherland, Midpoint Subdivision algorithm</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Polygon clipping-Sutherland Hodgeman algorithm, Weiler-Atherton algorithm, Three dimensional object representation-Polygon surfaces, Quadric surfaces – Basic 3D transformations</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>VI</td>
<td>Image processing – Introduction - Fundamental steps in image processing – digital image representations – relationship between pixels – gray level histogram – spatial convolution and correlation – edge detection – Robert, Prewitt, Sobel.</td>
<td>8</td>
<td>20%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAM**

**SECOND INTERNAL EXAM**

**END SEMESTER EXAM**
Question Paper Pattern (End semester exam)

1. There will be **FOUR** parts in the question paper – A, B, C, D

2. **Part A**
   a. Total marks : 40
   b. **TEN** questions, each have 4 marks, covering all the SIX modules (*THREE* questions from modules I & II; *THREE* questions from modules III & IV; *FOUR* questions from modules V & VI).
   
   *All the TEN* questions have to be answered.

3. **Part B**
   a. Total marks : 18
   b. **THREE** questions, each having 9 marks. One question is from module I; one question is from module II; one question *uniformly* covers modules I & II.
   c. *Any TWO* questions have to be answered.
   d. Each question can have *maximum THREE* subparts.

4. **Part C**
   a. Total marks : 18
   b. **THREE** questions, each having 9 marks. One question is from module III; one question is from module IV; one question *uniformly* covers modules III & IV.
   c. *Any TWO* questions have to be answered.
   d. Each question can have *maximum THREE* subparts.

5. **Part D**
   a. Total marks : 24
   b. **THREE** questions, each having 12 marks. One question is from module V; one question is from module VI; one question *uniformly* covers modules V & VI.
   c. *Any TWO* questions have to be answered.
   d. Each question can have *maximum THREE* subparts.

6. There will be **AT LEAST 50%** analytical/numerical questions in all possible combinations of question choices.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS403</td>
<td>PROGRAMMING PARADIGMS</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives:**
- To introduce the basic constructs that underlie all programming languages
- To introduce the basics of programming language design and implementation
- To introduce the organizational framework for learning new programming languages.

**Syllabus:**
Names, Scopes, and Bindings - Binding Time, Scope Rules, Storage Management, Overloading, Polymorphism; Control Flow - Expression Evaluation, Structured and Unstructured Flow, Non-determinacy; Data Types - Type Systems, Type Checking, Equality Testing and Assignment; Subroutines and Control Abstraction - Static and Dynamic Links, Calling Sequences, Parameter Passing, Exception Handling, Co-routines; Functional and Logic Languages; Data Abstraction and Object Orientation -Encapsulation, Inheritance, Dynamic Method Binding; Innovative features of Scripting Languages; Concurrency - Threads, Synchronization, Language-Level Mechanisms; Run-time program Management.

**Expected Outcome:**
The Students will be able to:
- i. compare scope and binding of names in different programming languages
- ii. analyze control flow structures in different programming languages
- iii. appraise data types in different programming languages
- iv. analyze different control abstraction mechanisms
- v. appraise constructs in functional, logic and scripting languages
- vi. analyze object oriented constructs in different programming languages
- vii. compare different concurrency constructs
- viii. interpret the concepts of run-time program management

**Text book:**

**References:**
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
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<tbody>
<tr>
<td>I</td>
<td>Names, Scopes and Bindings:- Names and Scopes, Binding Time, Scope Rules, Storage Management, Binding of Referencing Environments. Control Flow: - Expression Evaluation, Structured and Unstructured Flow, Sequencing, Selection, Iteration, Recursion, Non-determinacy.</td>
<td>7</td>
<td>15 %</td>
</tr>
<tr>
<td>II</td>
<td>Data Types:- Type Systems, Type Checking, Records and Variants, Arrays, Strings, Sets, Pointers and Recursive Types, Lists, Files and Input/Output, Equality Testing and Assignment.</td>
<td>7</td>
<td>15 %</td>
</tr>
<tr>
<td></td>
<td><strong>FIRST INTERNAL EXAM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Subroutines and Control Abstraction: - Static and Dynamic Links, Calling Sequences, Parameter Passing, Generic Subroutines and Modules, Exception Handling, Co-routines.</td>
<td>7</td>
<td>15 %</td>
</tr>
<tr>
<td>IV</td>
<td>Functional and Logic Languages:- Lambda Calculus, Overview of Scheme, Strictness and Lazy Evaluation, Streams and Monads, Higher-Order Functions, Logic Programming in Prolog, Limitations of Logic Programming.</td>
<td>7</td>
<td>15 %</td>
</tr>
<tr>
<td>V</td>
<td>Data Abstraction and Object Orientation:- Encapsulation, Inheritance, Constructors and Destructors, Aliasing, Overloading, Polymorphism, Dynamic Method Binding, Multiple Inheritance. Innovative features of Scripting Languages:- Scoping rules, String and Pattern Manipulation, Data Types, Object Orientation.</td>
<td>7</td>
<td>20 %</td>
</tr>
<tr>
<td>VI</td>
<td>Concurrency:- Threads, Synchronization, Run-time program Management:- Virtual Machines, Late Binding of Machine Code, Reflection, Symbolic Debugging, Performance Analysis.</td>
<td>7</td>
<td>20 %</td>
</tr>
<tr>
<td></td>
<td><strong>SECOND INTERNAL EXAM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>END SEMESTER EXAM</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. There will be **FOUR** parts in the question paper – A, B, C, D

2. **Part A**
   a. Total marks : 40
   b. **TEN** questions, each have **4 marks**, covering **all the SIX modules** (**THREE** questions from modules I & II; **THREE** questions from modules III & IV; **FOUR** questions from modules V & VI).  
   *All the TEN questions have to be answered.*

3. **Part B**
   a. Total marks : 18
   b. **THREE** questions, each having **9 marks**. One question is from module I; one question is from module II; one question **uniformly covers modules I & II**.  
   c. **Any TWO** questions have to be answered.  
   d. Each question can have **maximum THREE** subparts.

4. **Part C**
   a. Total marks : 18
   b. **THREE** questions, each having **9 marks**. One question is from module III; one question is from module IV; one question **uniformly covers modules III & IV**.  
   c. **Any TWO** questions have to be answered.  
   d. Each question can have **maximum THREE** subparts.

5. **Part D**
   a. Total marks : 24
   b. **THREE** questions, each having **12 marks**. One question is from module V; one question is from module VI; one question **uniformly covers modules V & VI**.  
   c. **Any TWO** questions have to be answered.  
   d. Each question can have **maximum THREE** subparts.

6. There will be **AT LEAST 50%** analytical/numerical questions in all possible combinations of question choices.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P –Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS405</td>
<td>COMPUTER SYSTEM ARCHITECTURE</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives:**
- To impart a basic understanding of the parallel architecture and its operations
- To introduce the key features of high performance computers

**Syllabus:**
Basic concepts of parallel computer models, SIMD computers, Multiprocessors and multi-computers, Cache Coherence Protocols, Multicomputers, Pipelining computers and Multithreading.

**Expected outcome :**
The Students will be able to :
- i. summarize different parallel computer models
- ii. analyze the advanced processor technologies
- iii. interpret memory hierarchy
- iv. compare different multiprocessor system interconnecting mechanisms
- v. interpret the mechanisms for enforcing cache coherence
- vi. analyze different message passing mechanisms
- vii. analyze different pipelining techniques
- viii. appraise concepts of multithreaded and data flow architectures

**Text Book:**

**References:**
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Parallel computer models - Evolution of Computer Architecture, System Attributes to performance, Amdahl's law for a fixed workload. Multiprocessors and Multicomputers, Multivector and SIMD computers, Architectural development tracks, Conditions of parallelism.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Processors and memory hierarchy - Advanced processor technology- Design Space of processors, Instruction Set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar and vector processors, Memory hierarchy technology.</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Message Passing Mechanisms-Message Routing schemes, Flow control Strategies, Multicast Routing Algorithms. Pipelining and Superscalar techniques – Linear Pipeline processors and Nonlinear pipeline processors</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Instruction pipeline design, Arithmetic pipeline deign - Super Scalar Pipeline Design</td>
<td>8</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Multithreaded and data flow architectures - Latency hiding techniques, Principles of multithreading - Multithreading Issues and Solutions, Multiple context Processors, Fine-grain Multicomputer- Fine-grain Parallelism. Dataflow and hybrid architecture</td>
<td>8</td>
<td>20%</td>
</tr>
</tbody>
</table>
Question Paper Pattern (End semester exam)

1. There will be **FOUR** parts in the question paper – A, B, C, D

2. **Part A**
   a. Total marks: 40
   b. **TEN** questions, each have 4 marks, covering all the **SIX** modules (THREE questions from modules I & II; THREE questions from modules III & IV; FOUR questions from modules V & VI). All the TEN questions have to be answered.

3. **Part B**
   a. Total marks: 18
   b. THREE questions, each having 9 marks. One question is from module I; one question is from module II; one question **uniformly** covers modules I & II.
   c. **Any TWO** questions have to be answered.
   d. Each question can have maximum **THREE** subparts.

4. **Part C**
   a. Total marks: 18
   b. THREE questions, each having 9 marks. One question is from module III; one question is from module IV; one question **uniformly** covers modules III & IV.
   c. **Any TWO** questions have to be answered.
   d. Each question can have maximum **THREE** subparts.

5. **Part D**
   a. Total marks: 24
   b. THREE questions, each having 12 marks. One question is from module V; one question is from module VI; one question **uniformly** covers modules V & VI.
   c. **Any TWO** questions have to be answered.
   d. Each question can have maximum **THREE** subparts.

6. There will be **AT LEAST 60%** analytical/numerical questions in all possible combinations of question choices.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P – Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS407</td>
<td>DISTRIBUTED COMPUTING</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives:**
- To introduce fundamental principles of distributed systems, technical challenges and key design issues.
- To impart knowledge of the distributed computing models, algorithms and the design of distributed system.

**Syllabus:**
Introduction to distributed computing, Design issues, Distributed Computing Models, System models, Inter-process communication, Distributed file system, Name Service, Distributed mutual exclusion, Distributed system design.

**Expected Outcome**
The Students will be able to:
1. distinguish distributed computing paradigm from other computing paradigms
2. identify the core concepts of distributed systems
3. illustrate the mechanisms of inter process communication in distributed system
4. apply appropriate distributed system principles in ensuring transparency, consistency and fault-tolerance in distributed file system
5. compare the concurrency control mechanisms in distributed transactional environment
6. outline the need for mutual exclusion and election algorithms in distributed systems

**Text Books:**

**References:**
2. M Solomon and J Krammer, Distributed Systems and Computer Networks, PHI

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Evolution of Distributed Computing -Issues in designing a distributed system- Challenges- Minicomputer model - Workstation model - Workstation-Server model- Processor - pool model - Trends in distributed systems</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>System models: Physical models - Architectural models - Fundamental models</td>
<td>6</td>
<td>15%</td>
</tr>
</tbody>
</table>
FIRST INTERNAL EXAM

| III | Interprocess communication: characteristics – group communication - Multicast Communication - Remote Procedure call - Network virtualization. Case study: Skype | 7 | 15% |
| IV | Distributed file system: File service architecture - Network file system - Andrew file system - Name Service | 7 | 15% |

SECOND INTERNAL EXAM

| V | Transactional concurrency control: Transactions, Nested transactions-Locks-Optimistic concurrency control | 7 | 20% |
| VI | Distributed mutual exclusion - central server algorithm - ring based algorithm - Maekawa's voting algorithm - Election: Ring-based election algorithm - Bully algorithm | 7 | 20% |

END SEMESTER EXAM

Question Paper Pattern

1. There will be **FOUR** parts in the question paper – A, B, C, D
2. **Part A**
   a. **Total marks : 40**
   b. **TEN questions, each have 4 marks**, covering all the SIX modules (**THREE questions from modules I & II; THREE questions from modules III & IV; FOUR questions from modules V & VI**). **All the TEN questions have to be answered.**
3. **Part B**
   a. **Total marks : 18**
   b. **THREE questions, each having 9 marks**. One question is from **module I**; one question is from **module II**; one question **uniformly covers modules I & II**.
   c. **Any TWO questions have to be answered.**
   d. Each question can have **maximum THREE** subparts.
4. **Part C**
   a. **Total marks : 18**
   b. **THREE questions, each having 9 marks**. One question is from **module III**; one question is from **module IV**; one question **uniformly covers modules III & IV**.
   c. **Any TWO questions have to be answered.**
   d. Each question can have **maximum THREE** subparts.
5. **Part D**
   a. **Total marks : 24**
   b. **THREE questions, each having 12 marks**. One question is from **module V**; one question is from **module VI**; one question **uniformly covers modules V & VI**.
   c. **Any TWO questions have to be answered.**
   d. Each question can have **maximum THREE** subparts.
6. There will be **AT LEAST 50%** analytical/numerical questions in all possible combinations of question choices.
Course Objectives:
- To introduce fundamental concepts of symmetric and asymmetric cipher models.
- To introduce fundamental concepts of authentication.
- To introduce network security and web security protocols.

Syllabus:

Expected Outcome:
The Students will be able to:
   i. summarize different classical encryption techniques
   ii. identify mathematical concepts for different cryptographic algorithms
   iii. demonstrate cryptographic algorithms for encryption/key exchange
   iv. summarize different authentication and digital signature schemes
   v. identify security issues in network, transport and application layers and outline appropriate security protocols

Text Books:

References:
2. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security, PHI, 2002

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Symmetric Cipher Models- Substitution techniques- Transposition techniques- Rotor machines-Steganography. Simplified DES- Block Cipher principles- The Data Encryption Standard, Strength of DES-Differential and linear Cryptanalysis. Block Cipher Design principles- Block Cipher modes of operations.</td>
<td>7</td>
<td>15 %</td>
</tr>
<tr>
<td>II</td>
<td>IDEA: Primitive operations- Key expansions- One round, Odd round, Even Round- Inverse keys for decryption. AES: Basic Structure- Primitive operation- Inverse Cipher- Key Expansion, Rounds, Inverse Rounds. Stream Cipher –RC4.</td>
<td>7</td>
<td>15 %</td>
</tr>
</tbody>
</table>
III Public key Cryptography: - Principles of Public key Cryptography Systems, Number theory- Fundamental Theorem of arithmetic, Fermat’s Theorem, Euler’s Theorem, Euler’s Totient Function, Extended Euclid’s Algorithm, Modular arithmetic. RSA algorithm- Key Management - Diffie-Hellman Key Exchange, Elliptic curve cryptography 7 15%

IV Authentication requirements- Authentication functions- Message authentication codes- Hash functions- SHA-1, MD5, Security of Hash functions and MACs- Authentication protocols-Digital signatures-Digital signature standards. 7 15%

SECOND INTERNAL EXAM


END SEMESTER EXAM

Question Paper Pattern (End semester exam)

1. There will be FOUR parts in the question paper – A, B, C, D

2. Part A
   a. Total marks : 40
   b. TEN questions, each have 4 marks, covering all the SIX modules (THREE questions from modules I & II; THREE questions from modules III & IV; FOUR questions from modules V & VI). All questions have to be answered.

3. Part B
   a. Total marks : 18
   b. THREE questions, each having 9 marks. One question is from module I; one question is from module II; one question uniformly covers modules I & II.
   c. Any TWO questions have to be answered.
   d. Each question can have maximum THREE subparts.

4. Part C
   a. Total marks : 18
   b. THREE questions, each having 9 marks. One question is from module III; one question is from module IV; one question uniformly covers modules III & IV.
   c. Any TWO questions have to be answered.
   d. Each question can have maximum THREE subparts.

5. Part D
   a. Total marks : 24
   b. THREE questions, each having 12 marks. One question is from module V; one question is from module VI; one question uniformly covers modules V & VI.
   c. Any TWO questions have to be answered.
   d. Each question can have maximum THREE subparts.

6. There will be AT LEAST 60% analytical/numerical questions in all possible combinations of question choices.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>451</strong></td>
<td>Seminar and Project Preliminary</td>
<td>0-1-4-2</td>
<td>2016</td>
</tr>
<tr>
<td></td>
<td><strong>Prerequisite : Nil</strong></td>
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<td></td>
</tr>
</tbody>
</table>

**Course Objectives**
- To develop skills in doing literature survey, technical presentation and report preparation.
- To enable project identification and execution of preliminary works on final semester project

**Course Plan**

**Seminar:** Each student shall identify a topic of current relevance in his/her branch of engineering, get approval of faculty concerned, collect sufficient literature on the topic, study it thoroughly, prepare own report and present in the class.

**Project preliminary:**
Identify suitable project relevant to the branch of study. Form project team (not exceeding four students). The students can do the project individually also. Identify a project supervisor. Present the project proposal before the assessment board (excluding the external expert) and get it approved by the board.
The preliminary work to be completed: (1) Literature survey (2) Formulation of objectives (3) Formulation of hypothesis/design/methodology (4) Formulation of work plan (5) Seeking funds (6) Preparation of preliminary report

*Note:* The same project should be continued in the eighth semester by the same project team.

**Expected outcome.**
The students will be able to
i. Analyse a current topic of professional interest and present it before an audience
ii. Identify an engineering problem, analyse it and propose a work plan to solve it.

**Evaluation**

<table>
<thead>
<tr>
<th>Seminar</th>
<th>: <strong>50 marks</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution of marks for the seminar is as follows: i. Presentation : 40% ii. Ability to answer questions : 30% &amp; iii. Report : 30%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project preliminary</th>
<th>: <strong>50 marks</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(Progress evaluation by the supervisor : 40% and progress evaluation by the assessment board excluding external expert : 60%. Two progress evaluations, mid semester and end semester, are mandatory.)</td>
<td></td>
</tr>
</tbody>
</table>

*Note:* All evaluations are mandatory for course completion and for awarding the final grade.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS431</td>
<td>COMPILER DESIGN LAB</td>
<td>0-0-3-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

Pre-requisite: CS331 System Software Lab

Course Objectives:
- To implement the different Phases of compiler.
- To implement and test simple optimization techniques.
- To give exposure to compiler writing tools.

List of Exercises/Experiments:
1. Design and implement a lexical analyzer for given language using C and the lexical analyzer should ignore redundant spaces, tabs and new lines.
2. Implementation of Lexical Analyzer using Lex Tool
3. Generate YACC specification for a few syntactic categories.
   a) Program to recognize a valid arithmetic expression that uses operator +, -, *, and /.
   b) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.
   c) Implementation of Calculator using LEX and YACC
   d) Convert the BNF rules into YACC form and write code to generate abstract syntax tree
4. Write program to find ε-closure of all states of any given NFA with ε transition.
5. Write program to convert NFA with ε transition to NFA without ε transition.
6. Write program to convert NFA to DFA
7. Write program to minimize any given DFA.
8. Develop an operator precedence parser for a given language.
9. Write program to find Simulate First and Follow of any given grammar.
10. Construct a recursive descent parser for an expression.
11. Construct a Shift Reduce Parser for a given language.
12. Write a program to perform loop unrolling.
13. Write a program to perform constant propagation.
15. Implement the back end of the compiler which takes the three address code and produces the 8086 assembly language instructions that can be assembled and run using an 8086 assembler. The target assembly instructions can be simple move, add, sub, jump etc.

Expected Outcome:
The Student will be able to:
   i. Implement the techniques of Lexical Analysis and Syntax Analysis.
   ii. Apply the knowledge of Lex & Yacc tools to develop programs.
   iii. Generate intermediate code.
   iv. Implement Optimization techniques and generate machine level code.
Course code | Course Name | L-T-P Credits | Year of Introduction
--- | --- | --- | ---
CS461 | COMPUTATIONAL GEOMETRY | 3-0-0-3 | 2016

**Course Objectives:**
- To introduce techniques for designing efficient algorithms for geometric problems.
- To discuss data structures used for geometric problems.
- To introduce combinatorial complexity of geometric problems.
- To study rigorous algorithmic analysis of geometric problems.

**Syllabus:**
Geometric preliminaries, Plane sweep technique, Line segment intersection, Point location, Searching, Triangulation, Art Gallery theorem, Linear programming, Arrangements of lines, Convex Hulls and Verona Diagrams.

**Expected Outcome:**
The Students will be able to:
- i. Develop efficient algorithms by exploiting geometric properties, and using appropriate data structures and geometric techniques.
- ii. Apply techniques and algorithms for solving problems in diversified fields like database searching, data mining, graphics and image processing, pattern recognition, computer vision, motion planning and robotics.
- iii. Perform complexity analysis of algorithms
- iv. Identify properties of geometric objects, express them as lemmas or theorems, and prove their correctness
- v. Implement geometric algorithms.

**Text Books:**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
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<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Geometric Preliminaries, DCEL (Doubly Connected Edge List) data structure, Polygon, Planar Straight Line Graph (PSLG) Area of a triangle, area of a polygon, Determinant used to test position of a point with respect to a directed line. Convex polygons, properties and point location in convex polygon (inside-outside test) Plane sweep algorithm, Algorithm for Line segment intersection problem using plane sweep technique.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Point location in PSLG – Slab method, Chain method and complexity analysis. Range Searching – 1D Range search, Kd Trees.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Polygon Triangulation: Regularization of polygons, properties of triangulations –Proofs, triangulation of monotone polygon – algorithm and complexity analysis. Linear Programming – Half plane intersection, Incremental algorithm and Randomized algorithm</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Art Gallery Theorem, Guarding Art Gallery, Fisk’s proof using three colouring. Arrangements of Lines – Duality, Combinatorics of arrangements, Zone Theorem, Algorithm for Constructing arrangements of lines.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Convex Hulls- Convex Hull Algorithms in the Plane -Graham’s Scan Algorithm, Jarvi’s March, Divide and Conquer Algorithm.</td>
<td>6</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Voronoi Diagrams- Properties and applications in the plane. Proofs of properties related to vertices and edges of voronoi diagrams Algorithm for constructing voronoi diagram. Delaunay Triangulation.</td>
<td>8</td>
<td>20%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAM**

**SECOND INTERNAL EXAM**

**END SEMESTER EXAM**

**Question Paper Pattern End semester exam)**

1. There will be **FOUR** parts in the question paper – A, B, C, D
2. **Part A**
   a. Total marks : 40
   b. **TEN** questions, each have **4 marks**, covering **all the SIX modules** (**THREE** questions from **modules I & II**: **THREE** questions from **modules III & IV**: **FOUR** questions from **modules V & VI**).
   All the TEN questions have to be answered.
3. **Part B**
   a. Total marks : 18
   b. **THREE** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question **uniformly covers** modules I & II.
   c. **Any TWO** questions have to be answered.
   d. Each question can have **maximum THREE** subparts.
4. **Part C**
   a. Total marks : 18
   b. **THREE** questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question **uniformly covers** modules III & IV.
   c. **Any TWO** questions have to be answered.
   d. Each question can have **maximum THREE** subparts.
5. Part D
   a. Total marks : 24
   b. **THREE** questions, each having **12 marks**. One question is from module V; one question is from module VI; one question **uniformly covers modules V & VI**.
   c. **Any TWO** questions have to be answered.
   d. Each question can have **maximum THREE** subparts.
5. There will be **AT LEAST 60%** analytical/numerical questions in all possible combinations of question choices.
Course Objectives:
- To introduce and discuss the fundamental concepts and applications of Digital Image Processing.
- To discuss various basic operations in Digital Image Processing.
- To know various transform domains.

Syllabus:
Introduction on digital image processing fundamentals; Image Transforms; Spatial and frequency domain filtering; Image segmentation; Morphological Image processing; Representation and Description.

Expected Outcome
The Students will be able to:
1. compare different methods for image acquisition, storage and representation in digital devices and computers
2. appreciate role of image transforms in representing, highlighting, and modifying image features
3. interpret the mathematical principles in digital image enhancement and apply them in spatial domain and frequency domain
4. apply various methods for segmenting image and identifying image components
5. summarise different reshaping operations on the image and their practical applications
6. identify image representation techniques that enable encoding and decoding images

Text Books:

References:

COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to Image processing: Fundamental steps in image processing; Components of image processing system; Pixels; coordinate conventions; Imaging Geometry; Spatial Domain; Frequency Domain; sampling and quantization; Basic relationship between pixels; Applications of Image Processing.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>Module</td>
<td>Content</td>
<td>Marks</td>
<td>Percentage</td>
</tr>
<tr>
<td>--------</td>
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<td>------------</td>
</tr>
<tr>
<td>II</td>
<td>Image transforms and its properties – Unitary transform; Discrete Fourier Transform; Discrete Cosine Transform; Walsh Transform; Hadamard Transform;</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Image Enhancement in Frequency Domain Basics of Filtering in Frequency Domain, Filters - Smoothing Frequency Domain Filters: Ideal Low Pass Filter; Gaussian Low Pass Filter; Butterworth Low Pass Filter; Sharpening Frequency Domain Filters: Ideal High Pass Filter; Gaussian High Pass Filter; Butterworth High Pass Filter; Homomorphic Filtering.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Image Segmentation: Pixel-Based Approach- Multi-Level Thresholding, Local Thresholding, Threshold Detection Method; Region-Based Approach- Region Growing Based Segmentation, Region Splitting, Region Merging, Split and Merge, Edge Detection - Edge Operators, Line Detection, Corner Detection.</td>
<td>8</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Morphological Operations Basics of Set Theory; Dilation and Erosion - Dilation, Erosion; Structuring Element; Opening and Closing; Hit or Miss Transformation. Representation and Description Representation - Boundary, Chain codes, Polygonal approximation approaches, Boundary segments.</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**Question Paper Pattern (End semester exam)**

1. There will be **FOUR** parts in the question paper – A, B, C, D
2. **Part A**  
   a. Total marks : 40  
   b. **TEN** questions, each have **4 marks**, covering **all the SIX modules** (*THREE* questions from modules I & II; *THREE* questions from modules III & IV; **FOUR** questions from modules V & VI).  
   *All the TEN* questions have to be answered.
3. Part B  
a. Total marks : 18  
b. THREE questions, each having 9 marks. One question is from module I; 
one question is from module II; one question uniformly covers modules I & II.  
c. Any TWO questions have to be answered.  
d. Each question can have maximum THREE subparts.  
4. Part C  
a. Total marks : 18  
b. THREE questions, each having 9 marks. One question is from module III; 
one question is from module IV; one question uniformly covers modules III & IV.  
c. Any TWO questions have to be answered.  
d. Each question can have maximum THREE subparts.  
5. Part D  
a. Total marks : 24  
b. THREE questions, each having 12 marks. One question is from module V; 
one question is from module VI; one question uniformly covers modules V & VI.  
c. Any TWO questions have to be answered.  
d. Each question can have maximum THREE subparts.  
6. There will be AT LEAST 60% analytical/numerical questions in all possible combinations of question choices.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS465</td>
<td>BIOINFORMATICS</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives:**
- To introduce concepts and data representations in bioinformatics
- To introduce fundamentals of Sequence alignment and Gene Recognition
- To discuss predictive methods using DNA and Protein Sequences

**Syllabus:**
Introduction to bioinformatics and molecular biology: Databases tools and their uses, Data searches and Pairwise Alignments, Multiple Sequence Alignments, Molecular Phylogenetic, Genomics and Gene Recognition, Protein and RNA structure Prediction

**Expected Outcome:**
The Students will be able to:
- interpret the concepts of bioinformatics
- identify different types of biological sequence
- analyse multiple sequences and find conserved regions
- predict RNA and Protein secondary structures
- analyse genomic sequences and identify encoded gene regions

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Bioinformatics and Computational Biology, Nature &amp; Scope of Bioinformatics. The central dogma of molecular biology and bio-sequences associated with it, RNA classification –coding and non coding RNA- mRNA, tRNA, miRNA and sRNA, RNAi. DNA and RNA structure – Nucleic Acid structure and function, Genetic Code, Genes and Evolution</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Importance of databases - Biological databases-primary sequence databases, Composite sequence databases- Secondary databases- nucleic acid sequence databases - Protein sequence data bases - structure databases, Types of databases, Data retrieval tools - Entrez</td>
<td>8</td>
<td>15%</td>
</tr>
</tbody>
</table>
### FIRST INTERNAL EXAM

<table>
<thead>
<tr>
<th>Module</th>
<th>Content</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Sequence alignment – local/global, pairwise sequence alignment, scoring methods. Needleman and Wunsch algorithm, global and local alignments. Multiple sequence alignment. Scoring matrices: basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, principles based on which these matrices are derived. Differences between distance &amp; similarity matrix. Introduction, Advantages, Phylogenetic Trees, Tree topologies, Methods for phylogenetic analysis- Distance Matrix methods, Character based methods. HMM (Hidden Markov Model): Introduction to HMM, Forward algorithm, Viterbi algorithm, applications in Bioinformatics</td>
<td>8</td>
<td>20%</td>
</tr>
<tr>
<td>IV</td>
<td>General introduction to Gene expression in prokaryotes and eukaryotes- Prokaryotic Genomes – Gene structure, GC content, Gene Density, Eukaryotic Genomes- Gene structure, GC content, Gene Density, Gene Expression, Transposition, Gene prediction approaches.</td>
<td>6</td>
<td>15%</td>
</tr>
</tbody>
</table>

### SECOND INTERNAL EXAM

<table>
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<tr>
<th>Module</th>
<th>Content</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>General introduction to Gene expression in prokaryotes and eukaryotes- Prokaryotic Genomes – Gene structure, GC content, Gene Density, Eukaryotic Genomes- Gene structure, GC content, Gene Density, Gene Expression, Transposition, Gene prediction approaches.</td>
<td>8</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Protein and RNA structure Prediction: Predicting RNA secondary structure - Nussinov Algorithm, Energy minimisation methods - Zuker Algorithm. Amino Acids, Polypeptide Composition, Protein Structures, Algorithm for protein folding, Structure prediction</td>
<td>6</td>
<td>15%</td>
</tr>
</tbody>
</table>

### END SEMESTER EXAM

**Question Paper Pattern (End semester exam)**

1. There will be **FOUR** parts in the question paper – A, B, C, D
2. **Part A**
   a. Total marks : 40
   b. **TEN** questions, each have **4 marks**, covering **all the SIX modules** (**THREE** questions from **modules I & II**; **THREE** questions from **modules III & IV**; **FOUR** questions from **modules V & VI**). **All the TEN** questions have to be answered.
3. **Part B**
   a. Total marks : 18
   b. **THREE** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question **uniformly** covers **modules I & II**.
   c. **Any TWO** questions have to be answered.
   d. Each question can have **maximum THREE** subparts.
4. **Part C**
   a. Total marks : 18
b. **THREE** questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question **uniformly** covers **modules III & IV**.

c. **Any TWO** questions have to be answered.

d. Each question can have **maximum THREE** subparts.

5. **Part D**

a. **Total marks : 24**

b. **THREE** questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question **uniformly** covers **modules V & VI**.

c. **Any TWO** questions have to be answered.

d. Each question can have **maximum THREE** subparts.

6. There will be **AT LEAST 60%** analytical/numerical questions in all possible combinations of question choices.
Course Objectives:
- To introduce the prominent methods for machine learning
- To study the basics of supervised and unsupervised learning
- To study the basics of connectionist and other architectures

Syllabus:
Introduction to Machine Learning, Learning in Artificial Neural Networks, Decision trees, HMM, SVM, and other Supervised and Unsupervised learning methods.

Expected Outcome:
The Students will be able to:
- i. differentiate various learning approaches, and to interpret the concepts of supervised learning
- ii. compare the different dimensionality reduction techniques
- iii. apply theoretical foundations of decision trees to identify best split and Bayesian classifier to label data points
- iv. illustrate the working of classifier models like SVM, Neural Networks and identify classifier model for typical machine learning applications
- v. identify the state sequence and evaluate a sequence emission probability from a given HMM
- vi. illustrate and apply clustering algorithms and identify its applicability in real life problems

References:
<table>
<thead>
<tr>
<th>II</th>
<th>Probably Approximately Learning (PAC), Noise, Learning Multiple classes, Model Selection and Generalization, Dimensionality reduction- Subset selection, Principle Component Analysis</th>
<th>8</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Classification- Cross validation and re-sampling methods- K-fold cross validation, Bootstrapping, Measuring classifier performance- Precision, recall, ROC curves. Bayes Theorem, Bayesian classifier, Maximum Likelihood estimation, Density functions, Regression</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>IV</td>
<td>Decision Trees- Entropy, Information Gain, Tree construction, ID3, Issues in Decision Tree learning- Avoiding Over-fitting, Reduced Error Pruning, The problem of Missing Attributes, Gain Ratio, Classification by Regression (CART), Neural Networks- The Perceptron, Activation Functions, Training Feed Forward Network by Back Propagation.</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>VI</td>
<td>Unsupervised Learning - Clustering Methods - K-means, Expectation-Maximization Algorithm, Hierarchical Clustering Methods, Density based clustering</td>
<td>6</td>
<td>15</td>
</tr>
</tbody>
</table>

## Question Paper Pattern

1. There will be **FOUR** parts in the question paper – A, B, C, D
2. **Part A**
   a. **Total marks : 40**
   b. **TEN** questions, each have **4 marks**, covering **all the SIX modules** (**THREE** questions from modules I & II; **THREE** questions from modules III & IV; **FOUR** questions from modules V & VI). **All the TEN** questions have to be answered.
3. **Part B**
   a. **Total marks : 18**
   b. **THREE** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question **uniformly** covers modules I & II.
   c. **Any TWO** questions have to be answered.
   d. Each question can have **maximum THREE** subparts.
4. Part C  
   a. Total marks : 18  
   b. **THREE** questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question uniformly covers **modules III & IV**.  
   c. *Any TWO* questions have to be answered.  
   d. Each question can have *maximum THREE* subparts.  
5. Part D  
   a. Total marks : 24  
   b. **THREE** questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question uniformly covers **modules V & VI**.  
   c. *Any TWO* questions have to be answered.  
   d. Each question can have *maximum THREE* subparts.  
6. There will be **AT LEAST 60%** analytical/numerical questions in all possible combinations of question choices.
Course code | Course Name | L-T-P Credits | Year of Introduction
---|---|---|---
CS469 | COMPUTATIONAL COMPLEXITY | 3-0-0-3 | 2016

Course Objectives:
- To introduce the fundamentals of computational complexity theory.
- To discuss basic concepts such as computational models, computational complexity measures (e.g., time and space complexity measures), complexity classes, reducibility and completeness notions.
- To familiarize the concepts of randomized and approximation algorithms and discuss the related complexity classes.

Syllabus:
Turing machines, decision problems, time and space complexity, polynomial time algorithms, NP and NP-completeness, standard time and space complexity classes, optimization problems and approximation algorithms, randomized algorithms and complexity classes based on randomized machine models, interactive proofs and their relation to approximation.

Expected Outcome
The Students will be able to:
- determine whether a problem is computable, and prove that some problems are not computable
- categorize problems into appropriate complexity classes
- classify problems based on their computational complexity using reductions
- analyse optimization problems using the concept of interactive proofs
- classify optimization problems into appropriate approximation complexity classes

Text Books:

References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks %</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Introduction:</strong> Easy and hard problems. Algorithms and complexity. <strong>Turing machines:</strong> Models of computation. Multi-tape deterministic and non-deterministic Turing machines. Decision problems</td>
<td>5</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Space complexity and hierarchy theorems: ( \text{DSPACE}[s] ). Linear Space Compression Theorem. ( \text{PSPACE}, \text{NPSPACE}. ) ( \text{PSPACE} = \text{NPSPACE} ). ( \text{PSPACE} )-completeness. Quantified Boolean Formula problem is ( \text{PSPACE} )-complete. L, NL and ( \text{NL} )-completeness. ( \text{NL} = \text{coNL} ). Hierarchy theorems.</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Randomized Complexity: The classes BPP, RP, ZPP. Interactive proof systems: IP = ( \text{PSPACE} ).</td>
<td>6</td>
<td>20%</td>
</tr>
</tbody>
</table>

**Question Paper Pattern (End semester exam)**

1. There will be **FOUR** parts in the question paper – A, B, C, D
2. **Part A**
   a. Total marks : 40
   b. **TEN** questions, each have **4 marks**, covering all the **SIX** modules (THREE questions from **modules I & II**; **THREE** questions from **modules III & IV**; **FOUR** questions from **modules V & VI**).
   All the **TEN** questions have to be answered.
3. **Part B**
   a. Total marks : 18
   b. **THREE** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question **uniformly covers modules I & II**.
   c. Any **TWO** questions have to be answered.
   d. Each question can have **maximum THREE** subparts.
4. **Part C**
   a. Total marks : 18
b. **THREE** questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question **uniformly** covers modules III & IV.

c. **Any TWO** questions have to be answered.

d. Each question can have **maximum THREE** subparts.

5. **Part D**

a. Total marks : **24**

b. **THREE** questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question **uniformly** covers modules V & VI.

c. **Any TWO** questions have to be answered.

d. Each question can have **maximum THREE** subparts.

6. There will be **AT LEAST 60%** analytical/numerical questions in all possible combinations of question choices.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS402</td>
<td>DATA MINING AND WAREHOUSING</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Course Objectives:
- To introduce the concepts of data Mining and its applications
- To understand investigation of data using practical data mining tools.
- To introduce Association Rules Mining
- To introduce advanced Data Mining techniques

Syllabus:
Data Mining, Applications, Data Mining Models, Data Warehousing and OLAP, Challenges, Tools, Data Mining Principles, Data Preprocessing: Data Preprocessing Concepts, Data Visualization, Data Sets and Their Significance, Classification Models, Multi Resolution Spatial Data Mining, Classifiers, Association Rules Mining, Cluster Analysis, Practical Data Mining Tools, Advanced Data Mining Techniques, Web Mining, Text Mining, CRM Applications and Data Mining, Data warehousing.

Expected Outcome:
The Student will be able to:
- i. identify the key process of Data mining and Warehousing
- ii. apply appropriate techniques to convert raw data into suitable format for practical data mining tasks
- iii. analyze and compare various classification algorithms and apply in appropriate domain
- iv. evaluate the performance of various classification methods using performance metrics
- v. make use of the concept of association rule mining in real world scenario
- vi. select appropriate clustering and algorithms for various applications
- vii. extend data mining methods to the new domains of data

Text Books:

References:
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Data Mining:- Concepts and Applications, Data Mining Stages, Data Mining Models, Data Warehousing (DWH) and On-Line Analytical Processing (OLAP), Need for Data Warehousing, Challenges, Application of Data Mining Principles, OLTP Vs DWH</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Data Preprocessing: Data Preprocessing Concepts, Data Cleaning, Data integration and transformation, Data Reduction, Discretization and concept hierarchy.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td><strong>FIRST INTERNAL EXAM</strong></td>
<td></td>
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</tr>
<tr>
<td>III</td>
<td>Classification Models: Introduction to Classification and Prediction, Issues regarding classification and prediction, Decision Tree- ID3, C4.5, Naive Bayes Classifier.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Rule based classification- 1R. Neural Networks-Back propagation. Support Vector Machines, Lazy Learners-K Nearest Neighbor Classifier. Accuracy and error Measures-evaluation. Prediction:-Linear Regression and Non-Linear Regression.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td><strong>END SEMESTER EXAMINATION</strong></td>
<td></td>
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</tr>
</tbody>
</table>
Question Paper Pattern

1. There will be \textbf{FOUR} parts in the question paper – A, B, C, D

2. Part A
   a. Total marks : 40
   b. \textit{TEN} questions, each have 4 \textbf{marks}, covering \textit{all the SIX modules} (\textit{THREE} questions from \textbf{modules I} \& \textbf{II}; \textit{THREE} questions from \textbf{modules III} \& \textbf{IV}; \textit{FOUR} questions from \textbf{modules V} \& \textbf{VI}).

   All the \textit{TEN} questions have to be answered.

3. Part B
   a. Total marks : 18
   b. \textit{THREE} questions, each having 9 \textbf{marks}. One question is from \textbf{module I}; one question is from \textbf{module II}; one question \textit{uniformly} covers \textbf{modules I} \& \textbf{II}.
   c. \textit{Any TWO} questions have to be answered.
   d. Each question can have \textbf{maximum THREE} subparts.

4. Part C
   a. Total marks : 18
   b. \textit{THREE} questions, each having 9 \textbf{marks}. One question is from \textbf{module III}; one question is from \textbf{module IV}; one question \textit{uniformly} covers \textbf{modules III} \& \textbf{IV}.
   c. \textit{Any TWO} questions have to be answered.
   d. Each question can have \textbf{maximum THREE} subparts.

5. Part D
   a. Total marks : 24
   b. \textit{THREE} questions, each having 12 \textbf{marks}. One question is from \textbf{module V}; one question is from \textbf{module VI}; one question \textit{uniformly} covers \textbf{modules V} \& \textbf{VI}.
   c. \textit{Any TWO} questions have to be answered.
   d. Each question can have \textbf{maximum THREE} subparts.

6. There will be \textbf{AT LEAST 60\%} analytical/numerical questions in all possible combinations of question choices.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P -Credits</th>
<th>Year of Introduction</th>
</tr>
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<tbody>
<tr>
<td>CS404</td>
<td>Embedded Systems</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives:**
- To introduce the technologies behind embedded computing systems.
- To introduce and discuss various software components involved in embedded system design and development.
- To expose students to the recent trends in embedded system design.

**Syllabus:**
Introduction to embedded systems, basic components, its characteristics. Modelling embedded systems, firmware development. Integration and testing of embedded systems, development environment. Characteristics of RTOS, interrupt handling, creating tasks in a typical RTOS. Embedded product development life cycle.

**Expected Outcome:**
The Student will be able to:

i. demonstrate the role of individual components involved in a typical embedded system
ii. analyze the characteristics of different computing elements and select the most appropriate one for an embedded system
iii. model the operation of a given embedded system
iv. substantiate the role of different software modules in the development of an embedded system
v. develop simple tasks to run on an RTOS
vi. examine the latest trends prevalent in embedded system design

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Fundamentals of Embedded Systems- complex systems and microprocessors- Embedded system design process .Specifications- architecture design of embedded system-design of hardware and software components- structural and behavioural description.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Hardware Software Co-Design and Program Modelling – Fundamental Issues, Computational Models- Data Flow Graph, Control Data Flow Graph, State Machine,. Sequential Model, Concurrent Model, Object oriented model, UML</td>
<td>9</td>
<td>15%</td>
</tr>
</tbody>
</table>
FIRST INTERNAL EXAMINATION

<table>
<thead>
<tr>
<th>III</th>
<th>Design and Development of Embedded Product – Firmware Design and Development – Design Approaches, Firmware Development Languages.</th>
<th>6</th>
<th>15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>Integration and Testing of Embedded Hardware and Firmware- Integration of Hardware and Firmware. Embedded System Development Environment – IDEs, Cross Compilers, Disassemblers, Decompilers, Simulators, Emulators and Debuggers.</td>
<td>6</td>
<td>15%</td>
</tr>
</tbody>
</table>

SECOND INTERNAL EXAMINATION

<table>
<thead>
<tr>
<th>V</th>
<th>RTOS based Design – Basic operating system services. Interrupt handling in RTOS environment. Design Principles. Task scheduling models. How to Choose an RTOS. Case Study – MicroC/OS-II.</th>
<th>9</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI</td>
<td>Networks – Distributed Embedded Architectures, Networks for embedded systems, Network based design, Internet enabled systems. Embedded Product Development Life Cycle – Description – Objectives -Phases – Approaches1. Recent Trends in Embedded Computing.</td>
<td>6</td>
<td>20%</td>
</tr>
</tbody>
</table>

END SEMESTER EXAM

Question Paper Pattern

1. There will be FOUR parts in the question paper – A, B, C, D
2. Part A
   a. Total marks : 40
   b. TEN questions, each have 4 marks, covering all the SIX modules (THREE questions from modules I & II; THREE questions from modules III & IV; FOUR questions from modules V & VI). All questions have to be answered.
3. Part B
   a. Total marks : 18
   b. THREE questions, each having 9 marks. One question is from module I; one question is from module II; one question uniformly covers modules I & II.
   c. Any TWO questions have to be answered.
   d. Each question can have maximum THREE subparts.
4. Part C
   a. Total marks : 18
   b. THREE questions, each having 9 marks. One question is from module III; one question is from module IV; one question uniformly covers modules III & IV.
   c. Any TWO questions have to be answered.
   d. Each question can have maximum THREE subparts.
5. Part D
   a. Total marks : 24
   b. THREE questions, each having 12 marks. One question is from module V; one question is from module VI; one question uniformly covers modules V & VI.
   c. Any TWO questions have to be answered.
   d. Each question can have maximum THREE subparts.
6. There will be AT LEAST 50% analytical/numerical questions in all possible combinations of question choices.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>492</td>
<td>PROJECT</td>
<td>6</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite : Nil

**Course Objectives**

- To apply engineering knowledge in practical problem solving
- To foster innovation in design of products, processes or systems
- To develop creative thinking in finding viable solutions to engineering problems

**Course Plan**

In depth study of the topic assigned in the light of the preliminary report prepared in the seventh semester

Review and finalization of the approach to the problem relating to the assigned topic

Preparing a detailed action plan for conducting the investigation, including team work

Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed

Final development of product/process, testing, results, conclusions and future directions

Preparing a paper for Conference presentation/Publication in Journals, if possible

Preparing a report in the standard format for being evaluated by the dept. assessment board

Final project presentation and viva voce by the assessment board including external expert

**Expected outcome**

The students will be able to

iii. Think innovatively on the development of components, products, processes or technologies in the engineering field

iv. Apply knowledge gained in solving real life engineering problems

**Evaluation**

Maximum Marks : 100

(i) Two progress assessments 20% by the faculty supervisor(s)
(ii) Final project report 30% by the assessment board
(iii) Project presentation and viva voce 50% by the assessment board

*Note:* All the three evaluations are mandatory for course completion and for awarding the final grade.
Course code | Course Name | L-T-P - Credits | Year of Introduction
--- | --- | --- | ---
CS462 | FUZZY SET THEORY AND APPLICATIONS | 3-0-0-3 | 2016

**Course Objectives:**
- To introduce the theory of fuzzy sets.
- To discuss theoretical differences between fuzzy sets and classical sets.
- To discuss fuzzy logic inference
- To introduce fuzzy arithmetic concepts.
- To discuss fuzzy inference applications in the area of control.

**Syllabus:**

**Expected Outcome:**
The Student will be able to:
- i. interpret fuzzy set theory and uncertainty concepts
- ii. identify the similarities and differences between probability theory and fuzzy set theory and their application conditions
- iii. apply fuzzy set theory in modeling and analyzing uncertainty in a decision problem
- iv. apply fuzzy control by examining simple control problem examples

**Text Books:**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Classical sets vs Fuzzy Sets - Need for fuzzy sets - Definition and Mathematical representations - Level Sets - Fuzzy functions - Zadeh’s Extension Principle.</td>
<td>06</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Operations on [0,1] - Fuzzy negation, triangular norms, t-</td>
<td>06</td>
<td>15%</td>
</tr>
</tbody>
</table>
### FIRST INTERNAL EXAMINATION

| III | Fuzzy Binary and n-ary relations - composition of fuzzy relations - Fuzzy Equivalence Relations - Fuzzy Compatibility Relations - Fuzzy Relational Equations | 07 | 15% |
| IV | Fuzzy Measures - Evidence Theory - Necessity and Belief Measures - Probability Measures vs Possibility Measures | 07 | 15% |

### SECOND INTERNAL EXAMINATION

| V | Fuzzy Decision Making - Fuzzy Relational Inference - Compositional Rule of Inference - Efficiency of Inference - Hierarchical | 08 | 20% |

### END SEMESTER EXAM

**Question Paper Pattern**

1. There will be **FOUR** parts in the question paper – A, B, C, D

2. **Part A**
   - a. Total marks : 40
   - b. **TEN** questions, each have **4 marks**, covering all the **SIX modules** (THREE questions from **modules I & II; THREE questions from modules III & IV; FOUR questions from modules V & VI**). **All questions have to be answered.**

3. **Part B**
   - a. Total marks : 18
   - b. **THREE** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question **uniformly** covers **modules I & II**.
   - c. **Any TWO** questions have to be answered.
   - d. Each question can have maximum **THREE** subparts.

4. **Part C**
   - a. Total marks : 18
   - b. **THREE** questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question **uniformly** covers **modules III & IV**.
   - c. **Any TWO** questions have to be answered.
   - d. Each question can have maximum **THREE** subparts.

5. **Part D**
   - a. Total marks : 24
   - b. **THREE** questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question **uniformly** covers **modules V & VI**.
   - c. **Any TWO** questions have to be answered.
   - d. Each question can have maximum **THREE** subparts.

6. There will be **AT LEAST 60%** analytical/numerical questions in all possible combinations of question choices.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS464</td>
<td>ARTIFICIAL INTELLIGENCE</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives:**
- To introduce basic principles that drive complex real world intelligence applications.
- To introduce and discuss the basic concepts of AI Techniques and Learning

**Syllabus:**

**Expected Outcome:**
The Student will be able to:
- i. appreciate the scope and limits of the artificial intelligence (AI) field
- ii. assess the applicability, strengths, and weaknesses of the basic knowledge representation
- iii. interpret the role of knowledge representation, problem solving, and learning
- iv. explain various search algorithms (uninformed, informed, and heuristic) for problem solving
- v. comprehend the fundamentals of Natural Language Processing

**Text Books:**

**References:**
2. Dan W Patterson, Introduction to Artificial Intelligence, Pearson, 2009
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Introduction</strong>: What is AI, The foundations of AI, History and applications, Production systems. Structures and strategies for state space search. Informed and Uninformed searches.</td>
<td>5</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Search Methods</strong>: data driven and goal driven search. Depth first and breadth first search, DFS with iterative deepening. Heuristic search-best first search, A * algorithm, AO* algorithm, Constraint Satisfaction. Crypt Arithmetic Problems</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>AI representational schemes- Semantic nets, conceptual dependency, scripts, frames, introduction to agent based problem solving, Machine learning-symbol based-a frame work for symbol based learning.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td><strong>Advanced Search</strong>: Heuristics in Games, Design of good heuristic-an example. Min-Max Search Procedure, Alpha Beta pruning.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>VI</td>
<td><strong>Expert Systems</strong>: rule based expert systems. Natural language processing-natural language understanding problem, deconstructing language. Syntax stochastic tools for language analysis, natural language applications</td>
<td>9</td>
<td>20%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

**SECOND INTERNAL EXAMINATION**

**END SEMESTER EXAM**

**Question Paper Pattern (End semester exam)**

1. There will be *FOUR* parts in the question paper – A, B, C, D
2. Part A
   a. Total marks : 40
   b. TEN questions, each have 4 marks, covering all the SIX modules (*THREE* questions from modules I & II; *THREE* questions from modules III & IV; *FOUR* questions from modules V & VI).
   *All the TEN* questions have to be answered.
3. Part B  
   a. Total marks : 18  
   b. THREE questions, each having 9 marks. One question is from module I; one question is from module II; one question uniformly covers modules I & II.  
   c. Any TWO questions have to be answered.  
   d. Each question can have maximum THREE subparts.

4. Part C  
   a. Total marks : 18  
   b. THREE questions, each having 9 marks. One question is from module III; one question is from module IV; one question uniformly covers modules III & IV.  
   c. Any TWO questions have to be answered.  
   d. Each question can have maximum THREE subparts.

5. Part D  
   a. Total marks : 24  
   b. THREE questions, each having 12 marks. One question is from module V; one question is from module VI; one question uniformly covers modules V & VI.  
   c. Any TWO questions have to be answered.  
   d. Each question can have maximum THREE subparts.

6. There will be AT LEAST 60% analytical/numerical questions in all possible combinations of question choices.
Course code | Course Name | L-T-P Credits | Year of Introduction
---|---|---|---
CS466 | DATA SCIENCE | 3-0-0-3 | 2016

Course Objectives:
- To introduce fundamental algorithmic ideas to process data.
- To introduce and discuss techniques for applying hypotheses and data into actionable predictions.
- To introduce documentation and visualization techniques.

Syllabus:
Modern scientific, engineering, and business applications are increasingly dependent on data, existing traditional data analysis analysis technologies were not designed for the complexity of the modern world. Data Science has emerged as a new, exciting and fast-paced discipline that explores novel statistical, algorithmic, and implementation challenges that emerge in processing, storing, and extracting knowledge from Big Data.

Expected Outcome:
The Student will be able to:
- i. explain and discuss the significance of data science and its key functionalities
- ii. discuss and demonstrate various models suitable for data science
- iii. perform preliminary statistical analysis using R language on simple data sets
- iv. perform python-based predication and filtering on simple data sets
- v. perform Hadoop and Map-Reduce for data analysis
- vi. perform data visualization techniques at a basic level

References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks %</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Data science process-roles, stages in data science project-working with data from files-working with relational databases-exploring data –managing data-cleaning and sampling for modeling and validation-introduction to NoSQL</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Module</td>
<td>Topic</td>
<td>Marks</td>
<td>Credits</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------</td>
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</tr>
<tr>
<td>II</td>
<td>Choosing and evaluating models-mapping problems to machine learning, evaluating clustering models, validating models-cluster analysis-k-means algorithm, Naive Bayes-Memorization Methods - Linear and logistic regression-unsupervised methods.</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>III</td>
<td>Reading and getting data into R- ordered and unordered factors - arrays and matrices lists and data frames - reading data from files - probability distributions - statistical models In R manipulating objects - data distribution.</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>IV</td>
<td>Python-based data visualization, predication through linear regression, collaborative filtering.</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>V</td>
<td>Introduction distributed file system mar reduce, Algorithm using Map Reduce –Matrix –Vector Multiplication by map reduce – Hadoop – Understanding Map Reduce architecture – writing Hadoop Map-Reduce programs-Loading data into HDFS Map-Reduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>VI</td>
<td>Documentation and deployment - producing effective presentations - introduction to graphical analysis – plot() function - display ing multivariate data - matrix plots multiple plots in one window - exporting graph - using graphics parameters. Case studies.</td>
<td>6</td>
<td>15</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAM**

**SECOND INTERNAL EXAM**

**END SEMESTER EXAM**

Question Paper Pattern (End semester exam)

1. There will be **FOUR** parts in the question paper – A, B, C, D
2. **Part A**
   a. **Total marks : 40**
   b. **TEN** questions, each have **4 marks**, covering all the SIX modules (**THREE** questions from modules I & II; **THREE** questions from modules III & IV; **FOUR** questions from modules V & VI).
   All the **TEN** questions have to be answered.
3. **Part B**
   a. **Total marks : 18**
   b. **THREE** questions, each having **9 marks**. One question is from module I; one question is from module II; one question **uniformly** covers modules I & II.
   c. **Any TWO** questions have to be answered.
   d. Each question can have maximum **THREE** subparts.
4. **Part C**
   a. **Total marks : 18**
   b. **THREE** questions, each having **9 marks**. One question is from module III; one question is from module IV; one question **uniformly** covers modules III & IV.
   c. **Any TWO** questions have to be answered.
   d. Each question can have maximum **THREE** subparts.
5. Part D
   a. Total marks : 24
   b. THREE questions, each having 12 marks. One question is from module V; one question is from module VI; one question uniformly covers modules V & VI.
   c. Any TWO questions have to be answered.
   d. Each question can have maximum THREE subparts.
6. There will be AT LEAST 40% analytical/numerical questions in all possible combinations of question choices.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P -Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS468</td>
<td>CLOUD COMPUTING</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives:**
- To impart the fundamentals of virtualization techniques.
- To introduce concepts and security issues of cloud paradigm.
- To introduce cloud computing based programming techniques and cloud services.

**Syllabus:**

**Expected Outcome:**
The Student will be able to:
- i. identify the significance of implementing virtualization techniques.
- ii. interpret the various cloud computing models and services.
- iii. compare the various public cloud platforms and software environments.
- iv. apply appropriate cloud programming methods to solve big data problems.
- v. appreciate the need of security mechanisms in cloud.
- vi. illustrate the use of various cloud services available online.

**Text Book:**

**References:**
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
</table>
| I      | INTRODUCTION TO VIRTUALIZATION  
Virtual Machines and Virtualization Middleware – Data Center  
| II     | INTRODUCTION TO CLOUD COMPUTING  
| IV     | CLOUD PROGRAMMING  
Parallel Computing and Programming Paradigms – Map Reduce – Twister – Iterative Map Reduce – Hadoop Library from Apache – Pig Latin High Level Languages- Mapping Applications to Parallel and Distributed Systems – Programming the Google App Engine – Google File System (GFS) – Big Table – Google’s NOSQL System | 7 | 15% |
| V      | SECURITY IN THE CLOUD  
| VI     | USING CLOUD SERVICES:  
Question Paper Pattern

1. There will be **FOUR** parts in the question paper – A, B, C, D

2. Part A
   a. Total marks : 40
   b. **TEN** questions, each have **4 marks**, covering all the SIX modules (**THREE** questions from modules I & II; **THREE** questions from modules III & IV; **FOUR** questions from modules V & VI).
      *All the TEN questions have to be answered.*

3. Part B
   a. Total marks : 18
   b. **THREE** questions, each having **9 marks**. One question is from module I; one question is from module II; one question *uniformly* covers modules I & II.
   c. **Any TWO** questions have to be answered.
   d. Each question can have *maximum THREE* subparts.

4. Part C
   a. Total marks : 18
   b. **THREE** questions, each having **9 marks**. One question is from module III; one question is from module IV; one question *uniformly* covers modules III & IV.
   c. **Any TWO** questions have to be answered.
   d. Each question can have *maximum THREE* subparts.

5. Part D
   a. Total marks : 24
   b. **THREE** questions, each having **12 marks**. One question is from module V; one question is from module VI; one question *uniformly* covers modules V & VI.
   c. **Any TWO** questions have to be answered.
   d. Each question can have *maximum THREE* subparts.

6. There will be **AT LEAST 50%** analytical/numerical questions in all possible combinations of question choices.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS472</td>
<td>PRINCIPLES OF INFORMATION SECURITY</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**
- To introduce fundamental concepts of security.
- To introduce and discuss the relevance of security in operating system, web services etc.
- To introduce fundamental concepts of secure electronic transactions.

**Syllabus**

**Expected Outcome:**
The Student will be able to:
- i. appreciate the common threats faced today
- ii. interpret the foundational theory behind information security
- iii. design a secure system
- iv. identify the potential vulnerabilities in software
- v. appreciate the relevance of security in various domains
- vi. develop secure web services and perform secure e-transactions

**Text Books:**

**References:**
2. V K Pachghare, Cryptography and information security, PHI

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Introduction:</strong> Overview of computer security, Security concepts, Need of Security- Threats- Deliberate software attacks, Deviation in quality of service, Attacks- malicious code, brute force, Timing attack, sniffer cases</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td><strong>Access Control Mechanisms</strong> - Access Control, Access control matrix, Access control in OS-Discretionary and Mandatory access control, Role-based access control, case study SELinux</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
II | **Security policies and models**: confidentiality policies, Bell-LaPadula model, Integrity policies, Biba model, Clark-Wilson models, Chinese wall model, waterfall model | 7 | 15% |
---|---|---|---|
III | **Software vulnerabilities**: Buffer and stack overflow, Cross-site scripting(XSS), and vulnerabilities, SQL injection and vulnerabilities, Phishing. | 6 | 15% |
IV | **Malware**: Viruses, Worms and Trojans. Topological worms. Internet propagation models for worms. | 6 | 15% |
---|---|---|---|
| **FIRST INTERNAL EXAMINATION** | | | |
| **SECOND INTERNAL EXAMINATION** | | | |
V | **Security in current domains**: Wireless LAN security - WEP details, wireless LAN vulnerabilities - frame spoofing. Cellphone security - GSM and UMTS security. Mobile malware - Bluetooth security issues. | 8 | 20% |
VI | **Secure Electronics transactions**: Framework, strength and weakness. Security in current applications: Online banking, Credit Card Payment Systems. **Web Services security**: XML, SOAP, SAML, RFID | 8 | 20% |
<p>| <strong>END SEMESTER EXAM</strong> | | | |
| | <strong>Question Paper Pattern (End semester exam)</strong> | | |
| 1. | There will be <strong>FOUR</strong> parts in the question paper – A, B, C, D | | |
| 2. <strong>Part A</strong> | | | |
| a. | <strong>Total marks : 40</strong> | | |
| b. | <strong>TEN</strong> questions, each have <strong>4 marks</strong>, covering all the <strong>SIX</strong> modules (<em>THREE</em> questions from modules I &amp; II; <em>THREE</em> questions from modules III &amp; IV; <em>FOUR</em> questions from modules V &amp; VI). <strong>All</strong> questions are to be answered. | | |
| 3. <strong>Part B</strong> | | | |
| a. | <strong>Total marks : 18</strong> | | |
| b. | <strong>THREE</strong> questions, each having <strong>9 marks</strong>. One question is from module I; one question is from module II; one question <strong>uniformly</strong> covers modules I &amp; II. <strong>Any TWO</strong> questions have to be answered. | | |
| c. | Each question can have <strong>maximum THREE</strong> subparts. | | |
| 4. <strong>Part C</strong> | | | |
| a. | <strong>Total marks : 18</strong> | | |
| b. | <strong>THREE</strong> questions, each having <strong>9 marks</strong>. One question is from module III; one question is from module IV; one question <strong>uniformly</strong> covers modules III &amp; IV. <strong>Any TWO</strong> questions have to be answered. | | |
| c. | Each question can have <strong>maximum THREE</strong> subparts. | | |
| 5. <strong>Part D</strong> | | | |
| a. | <strong>Total marks : 24</strong> | | |
| b. | <strong>THREE</strong> questions, each having <strong>12 marks</strong>. One question is from module V; one question is from module VI; one question <strong>uniformly</strong> covers modules V &amp; VI. <strong>Any TWO</strong> questions have to be answered. | | |
| c. | Each question can have <strong>maximum THREE</strong> subparts. | | |
| 6. | There will be <strong>AT LEAST 60%</strong> analytical/numerical questions in all possible combinations of question choices. | | |</p>
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>L-T-P-Credits</th>
<th>Year Of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>AE482</td>
<td>INDUSTRIAL INSTRUMENTATION</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**
- To equip the students with the basic knowledge of pressure, temperature, flow, level, density and viscosity measurements.
- To understand the construction and working of measuring instruments

**Syllabus**
- Temperature measurement
- Pressure measurement
- Measurement of viscosity
- Flow measurement
- Anemometers
- Target flow meters
- Level measurement

**Expected outcome**
- The student will be able to understand the various instruments used for industrial measurement.

**Text Books**

**Reference Books**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Temperature measurement: Resistance temperature detector (RTD), principle and types, construction requirements for industry, measuring circuits. Thermistors, principle and sensor types, manufacturing techniques, measuring circuits, linearization methods and applications. Pneumatic and suction pyrometers, integrated circuit sensors, diode type sensors, ultrasonic thermometers, Johnson noise thermometer, fluidic sensors, spectroscopic temperature measurements, thermograph, temperature switches and thermostats.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Pressure measurement basics, mechanical type instruments, electromechanical type, low pressure measurement, related accessories, pressure measuring standards, selection and application. Transmitter definition, classification, pneumatic transmitter-force balance type, torque balance type, two wire and four wire transmitters, I/P and P/I converters.</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>
First Internal Examination

III  Measurement of viscosity: definitions, units, Newtonian and Newtonian behaviour, measurement of viscosity using laboratory viscometers, industrial viscometers. Viscometer selection and application. Measurement of density, definitions, units, liquid density measurement, gas densitometers, its application and selection.  7  15%

IV  Flow measurement: Introduction, definitions and units, classification of flow meters, pitot tubes, positive displacement liquid meters and provers, positive displacement gas flow meters, variable area flow meters.  6  15%

Second Internal Examination

V  Anemometers: Hot wire/hot film anemometer, laser Doppler anemometer (LDA), electromagnetic flow meter, turbine and other rotary element flow meters, ultrasonic flow meters, doppler flow meters, cross correlation flow meters, vortex flow meters. Measurement of mass flow rate: radiation, angular momentum, impeller, turbine, constant torque hysteresis clutch, twin turbine Coriolis, gyroscopic and heat transfer type mass flow meters. Target flow meters: V-cone flow meters purge flow regulators, flow switches, flow meter calibration concepts, flow meter selection and application.  8  20%

VI  Level measurement: introduction, float level devices, displacer level devices, rotating paddle switches, diaphragm and deferential pressure detectors, resistance, capacitance and RF probes, radiation, conductivity, field effect, thermal, ultrasonic, microwave level switches, radar and vibrating type level sensors. Level sensor selection and application.  7  20%

End Semester Examination

Question Paper Pattern:

Maximum Marks: 100  Exam Duration: 3 Hours

Part A
Answer any two out of three questions from Module 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.  (15 x 2 = 30 marks)

Part B
Answer any two out of three questions from Module 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.  (15 x 2 = 30 marks)

Part C
Answer any two out of three questions from Module 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.  (20 x 2 = 40 marks)
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>AE484</td>
<td>INSTRUMENTATION SYSTEM DESIGN</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite**: NIL

**Course Objective**
- To equip the students with the basic Concept of Instrumentation system design
- To understand the construction and working of different instrumentation system

**Syllabus**
- Temperature measurement
- Pressure measurement
- Measurement of viscosity
- Flow measurement
- Anemometers
- Target flow meters
- Level measurement

**Expected outcome**
The students will be able to understand the concepts behind instrumentation system design and its working

**Text Books**

**Reference Books**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction: Concept of generalized measurement system, functional elements, generalized input-output configuration, static sensitivity, drifts, linearity, hysteresis, threshold, resolution, static stiffness and input-output impedance</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Transducers: Operating principle, construction and design of variable resistive transducers, variable inductive transducers, variable capacitive transducers, piezoelectric transducers, magnetostrictive transducers</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

| III    | Hall effect, eddy current, ionization, optical transducers, digital transducers, single shaft encoders, photo voltaic cell, photo conductive, photo emissive, fiber optic sensors, concept of smart and intelligent sensor, bio-sensors | 7     | 15%                 |
| IV     | Construction and performance of industrially important transducer for measuring displacement, speed, vibrations, temperature, electrical power, strain, torque Force, Design of intelligent instrumentation system. | 6     | 15%                 |

**SECOND INTERNAL EXAMINATION**

| V      | Signal Conditioning & Recording (Part1): Quarter, half and full bridge circuit, active filters, differential instrumentation amplifiers, carrier amplifiers | 8     | 20%                 |
| VI     | Signal Conditioning & Recording (Part2): design of display elements, LED, bar graph displays, LCDs, nixie tube and their interfacing | 7     | 20%                 |
END SEMESTER EXAMINATION

QUESTION PAPER PATTERN:

Maximum Marks: 100
Exam Duration: 3 Hours

Part A
Answer any two out of three questions from Module 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.  \((15 \times 2 = 30\text{ marks})\)

Part B
Answer any two out of three questions from Module 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.  \((15 \times 2 = 30\text{ marks})\)

Part C
Answer any two out of three questions from Module 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.  \((20 \times 2 = 40\text{ marks})\)
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>AO482</td>
<td>FLIGHT AGAINST GRAVITY</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**
- To introduce the basic concepts of aerospace engineering and the current developments in the field.

**Syllabus:**

**Text Book:**

**Reference:**

### Syllabus & Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>Historical Developments in Aeronautical Activities: Early air vehicles: Balloons, Biplanes and Monoplanes</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Helicopters; Developments in aerodynamics, aircraft materials, aircraft structures &amp; aircraft propulsion.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Aircraft Configurations: Different types of flight vehicles and their classifications;</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Components of fixed wing airplane and their functions;</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Airfoils, wings and other shapes.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>FIRST INTERNAL EXAMINATION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Principles of Atmospheric Flight: Physical properties and structure of the atmosphere:</td>
<td>3</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>The Standard Atmosphere, Temperature, Pressure and Altitude relationships, Mach number</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Evolution of theory of lift and drag, Maneuvers, Concepts of stability and control.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Introduction to Space Flight: Introduction to basic concepts, the upper atmosphere</td>
<td>3</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Space vehicle trajectories-some basic concepts, Kepler’s Laws of planetary motion.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>SECOND INTERNAL EXAMINATION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Introduction to airplane structures and materials: General types of construction, Monocoque, semi-monocoque.</td>
<td>3</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Typical wing and fuselage structure. Metallic and non-metallic materials</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use of aluminium alloy, titanium, stainless steel and composite materials.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Power plants used in airplanes: Basic ideas about piston, turboprop and jet engines.</td>
<td>3</td>
<td>20%</td>
</tr>
</tbody>
</table>
Comparative merits, Principles of operation of rocket, types of rockets and typical applications. 3
Exploration into space. 2

END SEMESTER EXAM

**Question Paper Pattern**

Maximum marks: 100 Exam duration: 3 hours

The question paper shall consist of three parts:

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note:** In all parts, each question can have a maximum of four sub questions, if needed.
<table>
<thead>
<tr>
<th>Course code.</th>
<th>Course Name</th>
<th>L-T-P -C</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU484</td>
<td>MICROPROCESSOR AND EMBEDDED SYSTEMS</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite: NIL

Course Objectives
- To impart the basic concepts of microprocessors
- To impart the basic concepts of embedded systems

Syllabus
Introduction to microprocessors, Intel 8085 microprocessor, Instruction Set of 8085, Assembly language programming, Interfacing I/O devices, Overview of embedded system, Intel 8051 microcontroller, 8051 interfacing, Other microcontroller architectures: PIC-Atmel AVR-ARM

Expected outcome.
The students will
i. Get idea about Intel 8085 Microprocessor
ii. Be able to do assembly language programming
iii. Gain an overview of embedded systems
iv. Know about Intel 8051 microcontroller and its interfacing

Text Books:

References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Introduction to microprocessors:</strong> Microcomputers and microprocessors, 8/16/32/ 64-bit microprocessor families. Internal architecture of Intel 8085 microprocessor: Block diagrams, Registers, Functional details of pins, Control signals.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Instruction Set of 8085:</strong> Instruction set, Instruction format, Addressing modes. Machine cycle and instruction cycles, Timing diagrams, Fetch and execute operations. <strong>Assembly Language Programming:</strong> Data copy operations, Arithmetic operations, Branching operations, Logic and bit manipulation instructions</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td><strong>Interfacing I/O devices:</strong> Interrupts, Programmable interface</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td><strong>Overview of Embedded System:</strong> Embedded System, Categories of Embedded System, Requirements of Embedded Systems, Challenges and Issues in Embedded Software Development, Major application areas of embedded system.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td><strong>Intel 8051 microcontroller:</strong> Architecture, Memory organization, Registers and I/O ports, Addressing modes, Instruction sets, Assembly language programming.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td><strong>8051 interfacing:</strong> Keyboard, Stepper motor, ADC, DAC, and LCD module interface. Frequency counter and temperature measurement. <strong>Other microcontroller architectures:</strong> Microchip technology PIC, Atmel AVR, ARM core processors.</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAMINATION**

**END SEMESTER EXAM**

**Question Paper Pattern**

Maximum marks: 100
Duration: 3 hrs

The question paper should consist of three parts

**Part A**
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note:** In all parts, each question can have a maximum of four sub questions, if needed.
Course code | Course Name | L-T-P - C | Year of Introduction
---|---|---|---
AU486 | Noise, Vibration and Harshness | 3-0-0-3 | 2016

Prerequisite : NIL

Course Objectives
- To impart the basics of noise, vibration, sources of vibration and noise in automobiles
- To study the effect of noise and vibration on human beings and nature
- To introduce the methods of measurement of noise and vibration.
- To provide knowhow on various methods to reduce the vibration and noise

Syllabus

Expected outcome.
The students will
i. understand the sources, effects, prediction, control techniques, measurement techniques of noise, vibration pertain to an automobile
ii. know about reduction of noise and vibration from an automobile.

Text Books:

References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Sound, General Introduction to Vibration, free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>---</td>
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<td>---</td>
</tr>
<tr>
<td>IV</td>
<td>Introduction to Transportation Noise and Vibration Sources, Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Reduction of noise and vibrations I: Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.</td>
<td>8</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Reduction of noise and vibrations; noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis. Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers</td>
<td>8</td>
<td>20%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

| III | Introduction to Transportation Noise and Vibration Sources, Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise | 7 | 15% |
| IV | Reduction of noise and vibrations I: Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers. | 7 | 15% |

**SECOND INTERNAL EXAMINATION**

| V | Reduction of noise and vibrations; noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis. Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers | 8 | 20% |

**END SEMESTER EXAM**
Question Paper Pattern

Maximum marks: 100
Duration: 3 hrs

The question paper should consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>BM482</td>
<td>BIOMEDICAL INSTRUMENTATION</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite : Nil

**Course Objectives**
- To impart knowledge about the principle and working of different types of biomedical electronic equipment/devices.

**Syllabus**

**Expected Outcome**
At the end of the course the students will be
i. Familiar with the principle and applications various analytical, diagnostic and therapeutic instruments
ii. Knowing the different methods and modalities used for medical imaging.

**Text Books:**

**Reference Books:**
3. John G Webster (Ed), Encyclopedia of Medical Devices and Instrumentation ,Wiley

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Origin of bioelectric potentials – resting and action potentials - propagation of action potentials – Examples of bioelectric potentials - ECG, EEG, EMG, ERG, EOG, EGG – Electrodes for measurement of biopotentials.</td>
<td>3</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Transducers for measurement of temperature, pressure &amp; displacement - Basic principles only</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Electrical activity of heart, electrocardiogram - lead systems - ECG machine – block diagram</td>
<td>2</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Cardiac pacemakers – internal and external pacemakers, defibrillators – basic principles. Measurement of heart sounds – phonocardiography</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Module</td>
<td>Description</td>
<td>Marks</td>
<td></td>
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<tr>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
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<td></td>
</tr>
<tr>
<td>V</td>
<td>Electrical activity of brain – Electro encephalogram – EEG measurement &amp; waveforms - block diagram. Evoked potential - types &amp; applications</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spiri meter - measurement of respiratory parameters.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Heart lung machine, Infant incubators, Infusion pumps, Artificial heart valves - Basic principles &amp; block diagram only.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lithotripsy – principles, types &amp; applications. Surgical diathermy - Basic principles &amp; block diagram only.</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAM**

**SECOND INTERNAL EXAM**

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>X-ray radiography - Principles of x-ray generation – Block diagram of x-ray machine - Description. Angiography - Basic principles</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>X-ray computed tomography - Principle of operation, sectional imaging, scanner configurations. Reconstruction of images - Iterative &amp; Fourier methods</td>
<td>5</td>
</tr>
<tr>
<td>VI</td>
<td>Ultrasonic imaging – Basic principles - Ultrasonic transducers &amp; Types - modes of image display-Principles &amp; applications. Doppler &amp; colour flow imaging</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MRI – Basic Principles - FID signal-excitation &amp; emission – Basic pulse sequences - Block diagram</td>
<td>3</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3 Hours

There shall be three parts for the question paper.

**Part A** includes Modules 1 & 2 and shall have three questions of fifteen marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

**Part B** includes Modules 3 & 4 and shall have three questions of fifteen marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

**Part C** includes Modules 5 & 6 and shall have three questions of twenty marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

**Note:** Each part shall have questions uniformly covering both the modules in it.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>BM484</td>
<td>MEDICAL IMAGING &amp; IMAGE PROCESSING TECHNIQUES</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**
- To introduce the underlying principles of biomedical imaging modalities such as US, X-ray, CT, SPECT, PET and MRI
- To provide an overview of the image processing techniques used in these images

**Syllabus**
Imaging Techniques – X-ray - CT, Nuclear medicine imaging modalities - SPECT and PET, Ultrasound Imaging - Doppler ultrasound, Magnetic resonance imaging –T1, T2 and Proton density weighted, Thermography and Microwave imaging, Image sampling and quantization, Image enhancement - spatial and frequency domain methods, Image segmentation-edge based and region based.

**Expected Outcome**
The students will be able to
i. Identify major processes involved in formation of medical images
ii. Recognize the imaging modality from their visualizations
iii. Classify the various medical image processing algorithms
iv. Describe fundamental methods for image enhancement and segmentation

**Reference Books:**
2. Atam P Dhawan , Medical Imaging Analysis, Wiley Interscience publication, 2003

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>X-ray imaging – basic principles of image formation – block diagram of an x-ray machine. Digital radiography - basic principles. X-ray Computed Tomography - basic principles, contrast scale, different generations of CT scanners, basic principles of image reconstruction.</td>
<td>3</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Ultrasonic imaging – Physical principles, Transducer parameters, Different modes - A-mode, M-mode (echocardiograph), B-mode. Principles of Doppler ultrasonic imaging.</td>
<td>4</td>
<td>15%</td>
</tr>
<tr>
<td>Module</td>
<td>Description</td>
<td>Marks</td>
<td>Weightage</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------</td>
<td>-----------</td>
</tr>
<tr>
<td>I</td>
<td>Magnetic Resonance Imaging – Principles of MRI, T1 weighted, T2 weighted and proton density weighted images, applications of MRI</td>
<td>3</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAM**

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
<th>Marks</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Nuclear medicine imaging modalities - Emission Computed Tomography – SPECT &amp; PET</td>
<td>4</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Thermography - Physics of thermography, applications of thermography</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Image sampling and quantization, Image enhancement in spatial domain-gray level transformations, histogram processing</td>
<td>4</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Smoothing and sharpening, spatial filters</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAM**

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
<th>Marks</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Image enhancement in frequency domain - filtering - low pass high pass, band pass and band stop filters</td>
<td>4</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Homomorphic filter, Zooming operation</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Image segmentation - detection of discontinuities - point, line, edge, edge-based image segmentation - edge linking and boundary detection</td>
<td>4</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Region based segmentation - region growing, region splitting and merging</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3 Hours

There shall be three parts for the question paper.

**Part A** includes Modules 1 & 2 and shall have three questions of fifteen marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

**Part B** includes Modules 3 & 4 and shall have three questions of fifteen marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

**Part C** includes Modules 5 & 6 and shall have three questions of twenty marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

**Note:** Each part shall have questions uniformly covering both the modules in it.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>BT362</td>
<td>Sustainable Energy Processes</td>
<td>3-0-0</td>
<td>3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**

- To introduce the current and potential future energy systems, covering resources, extraction, conversion, and applications, with emphasis on meeting regional and global energy needs in a sustainable manner.

**Syllabus**

Classification of energy, extraction, conversion, and applications of solar energy, wind energy, ocean energy, biomass energy, fuel cells and hydrodynamic systems, merits and demerits of various energy systems, energy storage.

**Expected outcome**

Students who successfully complete this course should be able to

i. Identify global and Indian energy sources.

ii. Explain capture, conversion and application of solar and wind energy.

iii. Explain conversion of biomass to energy.

iv. Explain the capture of energy from oceans.

v. Explain fuel cells and energy storage routes.

**Reference Books**


**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
</table>

FIRST INTERNAL EXAM
| III | Wind energy. Availability of wind energy, Site characteristics, Wind turbine types-horizontal axis and vertical axis-design principles of wind turbine. Wind power plants, Wind energy storage. Safety and environmental aspects. Merits and limitations of wind energy. | 7 | 15% |
| V  | Energy from the oceans. Ocean thermal electric conversion. Tidal energy conversion. Geothermal energy conversion. Hydro power-global and Indian scenario. Positive and negative attributes of hydropower. Electricity from hydropower. Small hydropower. | 7 | 20% |

**END SEMESTER EXAMINATION**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100

Exam Duration: 3 hours

The question paper consists of Part A, Part B and Part C.

Part A consists of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer two questions (15×2=30 marks).

Part B consists of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer two questions (15×2=30 marks).

Part C consists of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer two questions (20×2=40 marks).

For each question there can be a maximum of 4 subparts.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>BT461</td>
<td>Design of Biological Wastewater Treatment Systems</td>
<td>3-0-0</td>
<td>3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**

- To provide the necessary theoretical background for the design of most common biological waste treatment systems.

**Syllabus**

Characteristics and *impacts of wastewater on* the environment, basic design considerations, types of biological treatment processes and reactors, aerobic suspended growth systems, anaerobic digesters, design consideration for upflow anaerobic sludge blanket reactors, biogas production.

**Expected outcome**

A student who successfully completes this course will be able to

i. Explain the characteristics of wastewater.

ii. Identify different types of reactors for wastewater treatment.

iii. Design a completely mixed activated sludge system.

iv. Explain the design features of an upflow anaerobic sludge blanket reactor.

v. Explain the factors affecting biogas production.

**Reference Books**


<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Wastewater-origin, characteristics, <em>impacts of wastewater on</em> the environment, basic design considerations-estimation of wastewater quantities, variation in wastewater flow rates-average daily flow, maximum daily flow, peak hourly flow, minimum daily flow, minimum hourly flow, process flow sheet, reactor considerations.</td>
<td>5</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Objectives and fundamentals of biological treatment, types of biological treatment processes, types of reactors used for wastewater treatment process, kinetics of biological treatment systems-batch and continuous systems, biological nitrogen removal, biological phosphorous removal.</td>
<td>5</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAM**
| III | Aerobic suspended growth systems- Conventional activated sludge processes and its modifications-theoretical principles, design of completely mixed activated sludge system, F/M ratio, hydraulic loading, MLSS, MLVSS, sludge age, sludge return, calculation of the reactor volume, production and removal of excess sludge, sludge volume index, Solids Retention Time (SRT) or Mean Cell Residence Time, oxygen requirements. | 8 | 15% |
| IV | Aerobic attached growth system-Trickling filters-theoretical principles, classification, design principles, process design considerations, Oxidation ponds-construction and design considerations, aerobic sludge digestion, waste stabilization ponds, oxidation ditches-theory and design, factors affecting the design, theory and design of rotating biological contactors | 8 | 15% |
| V | Fundamentals of anaerobic treatment, types of anaerobic digesters- conventional systems, high-rate systems and combined treatment systems, design of upflow anaerobic sludge blanket reactors, anaerobic sequencing batch reactor, anaerobic filters-upflow and downflow anaerobic filters, sludge treatment and disposal, sludge digestion, sludge drying, sludge conditioning, sludge drying characteristics. | 8 | 20% |
| VI | Biogas technology-microbiology of biogas production, process parameters for a biogas plant, biogas yield from different substrates, methods to enhance biogas production-effect of heating, insulation and stirring on gas production, basic components of a biogas plant, biogas plant designs-continuous type plants, semi-continuous plants, fixed dome type, floating gasholder digester (KVIC), kinetic models for predicting biogas production, design equations of biogas plants. | 8 | 20% |

**SECOND INTERNAL EXAMINATION**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3 hours

The question paper consists of Part A, Part B and Part C.

Part A consists of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer two questions (15×2=30 marks).

Part B consists of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer two questions (15×2=30 marks).

Part C consists of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer two questions (20×2=40 marks).

For each question there can be a maximum of 4 subparts.
Prerequisites: Nil

Course Objectives:
- To study the various types of environmental pollution
- To study the impact of various types of pollutants and their assessment techniques

Syllabus:
Pollution, Types. Air pollution—sources, effects, types of pollutants. Water pollution, characteristics of water pollutants, Solid wastes, sources, types, soil pollution, pesticide pollution. Noise pollution, Impacts, positive and negative Environmental impact assessment, steps of doing EIA, methodology adopted, EIA procedure in India, Case studies.

Course Outcomes:
- The students will have a basic knowledge of various pollution sources and their impacts

Text Books / References:
3. John Glasson, Riki Therivel & S Andrew Chadwick “Introduction to EIA” University College London Press Limited
5. Mackenzie L Davis, Introduction to Environmental Engineering, McGraw hill Education (India)

COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks %</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>INTRODUCTION: Classification of Pollution and Pollutants, AIR POLLUTION: Primary and Secondary Pollutants, air pollutants-sulfur dioxide- nitrogen dioxide, carbon monoxide, Impact of air pollutants on human, vegetation and environment, Ambient Air Quality Standards</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>II</td>
<td>WATER POLLUTION: Point and Non-point Source of Pollution, Major Pollutants of Water, Physical, chemical and biological characteristics of water, Water borne diseases, Water Quality standards</td>
<td>7</td>
<td>15</td>
</tr>
</tbody>
</table>
### FIRST INTERNAL EXAMINATION

<table>
<thead>
<tr>
<th>Module</th>
<th>Topics</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>SOLID WASTE: Classification and sources of Solid Waste, Characteristics of Solid Waste, e waste, Radioactive wastes</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>LAND/SOIL POLLUTION: Effects of urbanization on land degradation, Impact of Modern Agriculture on Soil, pesticide pollution, Effect on Environment</td>
<td>15</td>
</tr>
<tr>
<td>IV</td>
<td>NOISE POLLUTION: Sources of Noise, Effects of Noise, measurement of noise, Equivalent sound pressure level, Control measures</td>
<td>6</td>
</tr>
</tbody>
</table>

### SECOND INTERNAL EXAMINATION

<table>
<thead>
<tr>
<th>Module</th>
<th>Topics</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Impacts of pollutants, types, scale of impact-Global, local pollutants. Climate change, Ozone layer depletion, Deforestation, land degradation Environmental impact assessment, Need for EIA</td>
<td>8</td>
</tr>
<tr>
<td>VI</td>
<td>EIA Procedure-Screening, Scoping, EIA procedure in India, Impact analysis- checklists, matrix methods, overlay analysis, Case studies of EIA</td>
<td>8</td>
</tr>
</tbody>
</table>

### END SEMESTER EXAMINATION

#### QUESTION PAPER PATTERN (External Evaluation):

- **Maximum Marks**: 100
- **Exam Duration**: 3 Hrs

- **Part A - Module I & II**: 2 questions out of 3 questions carrying 15 marks each
- **Part B - Module III & IV**: 2 questions out of 3 questions carrying 15 marks each
- **Part C - Module V & VI**: 2 questions out of 3 questions carrying 20 marks each

**Note**:

1. Each part should have at least one question from each module
2. Each question can have a maximum of 4 subdivisions (a, b, c, d)
Course Code: CE484  
Course Name: APPLIED EARTH SYSTEMS  
L-T-P-Credits: 3-0-0-3  
Year of Introduction: 2016

Prerequisites: Nil

Course objectives:
- Appreciation of earth as a system of interrelated components
- Understanding mechanisms that give rise to oceanographic and atmospheric phenomena
- Comprehension of processes that result in characteristic land features in different climatic regimes

Syllabus:

Expected Outcomes:
- The students would understand the roles of surface and sub surface phenomena in shaping surface features of earth
- The course would appreciate the ramifications of any atmospheric, oceanographic or land process on other component subsystems including biosphere.

Text Books / References:
**OURSE PLAN**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks %</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Fundamental concepts of equilibrium. Geomorphic agents and processes. Basic concept of Earth as a system and its component sub systems. Climate Change vis-a-vis the interrelationships of the subsystems- Green House Effect and Global warming, basic ideas about their causes and effects.</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>II</td>
<td>Weathering- relevance, influence of and on earth systems, types and controlling factors. Fluvial processes-hydrological cycle, fluvial erosion, transportation and deposition, fluvial landforms. Stages of stream development; Drainage patterns.</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>III</td>
<td>Soil- formation and controls, soil profile, soil erosion and conservation methods. Deserts-distribution and controls.</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>IV</td>
<td>Wagner’s ideas of continental drift, Plate Tectonics- seafloor spreading. Plate boundaries and their features, mechanisms of plate movements.</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>V</td>
<td>Basics of oceanography: coastal upwelling and downwelling. Outlines of ocean floor topography, Brief account of marine sediments, turbidity currents, basic outlines of origin and circulation of deep sea surface currents (Atlantic and Pacific Oceans), coral reefs- types and concepts about their formation. Basic ideas about plankton and primary productvity.</td>
<td>7</td>
<td>20</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Soil- formation and controls, soil profile, soil erosion and conservation methods. Deserts-distribution and controls.</td>
</tr>
<tr>
<td>IV</td>
<td>Wagner’s ideas of continental drift, Plate Tectonics- seafloor spreading. Plate boundaries and their features, mechanisms of plate movements.</td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Basics of oceanography: coastal upwelling and downwelling. Outlines of ocean floor topography, Brief account of marine sediments, turbidity currents, basic outlines of origin and circulation of deep sea surface currents (Atlantic and Pacific Oceans), coral reefs- types and concepts about their formation. Basic ideas about plankton and primary productvity.</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAMINATION**

**QUESTION PAPER PATTERN (End Semester Exam)**

Maximum Marks : 100  
Exam Duration: 3 Hrs

Part A - Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV : 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1.Each part should have at least one question from each module

2.Each question can have a maximum of 4 subdivisions (a,b,c,d)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P-C</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE486</td>
<td>GEOINFORMATICS FOR INFRASTRUCTURE MANAGEMENT</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisites: Nil

Course objectives:
- To expose the concept of GIS and Remote sensing
- To introduce the applications of GIS and Remote sensing for infrastructure management

Syllabus:

Course Outcomes:
The students will
- Understand various satellite data products and their uses.
- Know about the Geospatial data and its importance in Spatial analysis.
- Apply Geoinformatics techniques in various engineering applications and for infrastructure development.

Text Books / References:

**COURSE PLAN**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem Exam Marks %</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Remote Sensing: Energy sources and radiation principles-Interaction of EM energy with atmosphere and surface features,</td>
<td>7</td>
<td>15</td>
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<tr>
<td>Question Paper Pattern (End semester examination)</td>
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<tr>
<td><strong>Part A - Module I &amp; II</strong></td>
<td>2 questions out of 3 questions carrying 15 marks each</td>
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<tr>
<td><strong>Part B - Module III &amp; IV</strong></td>
<td>2 questions out of 3 questions carrying 15 marks each</td>
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<tr>
<td><strong>Part C - Module V &amp; VI</strong></td>
<td>2 questions out of 3 questions carrying 20 marks each</td>
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</tbody>
</table>

**Note:**
1. Each part should have at least one question from each module
2. Each question can have a maximum of 4 subdivisions (a,b,c,d)
Course Code: CE488  
Course Name: DISASTER MANAGEMENT  
L-T-P-Credits: 3-0-0-3  
Year of Introduction: 2016

Course Objectives
- To provide an overview of the common hazards and their dynamics
- To inculcate the basic concepts of disaster management

Syllabus

Expected Outcome
The students will
i. get general ideas about the processes involved in natural and anthropogenic disasters
ii. understand the concepts of disaster management and measures to mitigate and contain common episodes of disasters

References:

COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Fundamental concepts of hazards and disasters: Introduction to key concepts and terminology of hazard, vulnerability, exposure, risk, crisis, emergencies, Disasters, Resilience. Basic concept of Earth as a system and its component sub systems. Climate Change vis-a-vis the interrelationships of the subsystems- Green House Effect and Global warming. basic</td>
<td>7</td>
<td>15%</td>
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<tr>
<td>Part</td>
<td>Module</td>
<td>Description</td>
<td>Marks</td>
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<tr>
<td>II</td>
<td>Types of Natural Disasters I- Earth quakes, Landslides. Nature of impacts.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Types of Natural Disasters II- Floods, Coastal disasters- Cyclones, Tsunamis. Nature of impacts.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Types of Anthropogenic Disasters I- soil and soil degradation, desertification.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Types of Anthropogenic Disasters II-Fundamental concepts of water and atmospheric pollution.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Hazard and disaster management plans for floods, tidal waves.</td>
<td>7</td>
<td>20%</td>
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</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

**SECOND INTERNAL EXAMINATION**

**END SEMESTER EXAMINATION**

**QUESTION PAPER PATTERN (End Semester Examination)**

Maximum Marks :100  
Exam Duration: 3 Hrs

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each
Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each
Part C - Module V &VI : 2 questions out of 3 questions carrying 20 marks each

**Note:**
1. Each part should have at least one question from each module
2. Each question can have a maximum of 4 subdivisions (a,b,c,d)
Pre-requisites: Nil

Course Objectives:
- To introduce the different types of hazards in industries and the management of hazards.
- To learn the various types of pollution.

Syllabus:
Occupational health and toxicology- Lead-nickel, chromium and manganese toxicity-gas poisoning-Industrial hygiene, Physical, chemical and biological hazards, Safety and Health Management, noise-effects, source, Electrical Hazards and Hazards in Construction Industry, Air pollution, Water pollution, Hazardous Waste Management, pollution control in different industries

Expected Outcomes:
The students will
i. Be able to understand the various occupational hazards and the techniques that can be adopted for managing hazards and related problems
ii. Become aware regarding air pollution and water pollution problems and pollution control in industries

Text Books / References:
1. Gerard Kiely, Environmental Engineering, McGraw hill Education
2. Mackenzie L Davis, Introduction to Environmental Engineering, McGraw hill Education (India)

<p>| COURSE PLAN |</p>
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Occupational Health And Toxicology: occupational related diseases, silicosis, asbestosis, pneumoconiosis, etc. lead, nickel, chromium and manganese toxicity, effects and prevention –Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects. Industrial Hygiene.</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>
II
7 15%

FIRST INTERNAL EXAMINATION

III
Radiation and Industrial Hazards, Types and effects of radiation on human body, disposal of radioactive waste Air Pollution - air pollutants from industries, effect on human health, animals, Plants and Materials - concept of clean coal combustion technology - depletion of ozone
6 15%

IV
Electrical Hazards, Protection against voltage fluctuations, Effects of shock on human body. Introduction of Construction industry, Scaffolding and Working platform, Welding and Cutting, Excavation Work, Concreting and Cementing work, Transportation of men and material,
6 15%

SECOND INTERNAL EXAMINATION

V
Water Pollution -water pollutants-health hazards - effluent quality standards, tannery, textile effluents Hazardous Waste Management -waste identification, characterization and classification, health hazards-toxic and radioactive wastes-recycling and reuse.
8 20%

VI
8 20%

END SEMESTER EXAMINATION

QUESTION PAPER PATTERN (External Evaluation) :

Maximum Marks :100 Exam Duration: 3 Hrs

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each
Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each
Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1.Each part should have at least one question from each module
2.Each question can have a maximum of 4 subdivisions (a,b,c,d)
Course code | Course Name | L-T-P-Credits | Year of Introduction
---|---|---|---
CH482 | PROCESS UTILITIES AND PIPE LINE DESIGN | 3-0-0-3 | 2016

Prerequisite: Nil

Course Objectives

1. To impart the basic concepts of project engineering
2. To develop understanding about process auxiliaries and utilities in process industries

Syllabus

Process Auxiliaries: Piping design, Piping insulation, Piping fittings, Valves, Pumps, Process control and instrumentation diagram.

Process Utilities: Process Water, Steam, Compressors and Vacuum Pumps, Methods of vacuum development and their limitations, materials handling under vacuum. Refrigeration and Chilling systems, Oil heating systems, Nitrogen systems

Expected Outcome

After successful completion of the course the students will be able to

i. Acquire the overall knowledge about the process plant.
ii. Understand the importance of process auxiliaries and utilities in process industries.
iii. Learn the conceptual design of chemical process plant.
iv. Build a bridge between theoretical and practical concepts used for process auxiliaries and utilities in any process industry.

References:


Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Process Auxiliaries: Basic considerations and flow diagrams in chemical engineering plant design. Piping design: Selection of material, pipe sizes, working pressure, Basic principles of piping design, piping drawings, pipe installations, overhead installations, Process steam piping, selection and determination of steam – pipe size, Piping insulation, application of piping insulation, weather proof and fire resisting pipe insulation jackets, piping fittings, pipe joints</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>II</td>
<td>Valves: Types of valves, selection criteria of valves for various systems. Pumps: Types of pumps, NPSH requirement, pump location, pump piping, pump piping support. Process control and instrumentation diagram, control system design for process auxiliaries.</td>
<td>7</td>
<td>15</td>
</tr>
</tbody>
</table>
FIRST INTERNAL EXAMINATION

III Process Utilities: Process Water: Sources of water, hard and soft water, Requisites of industrial water and its uses, Methods of water treatment, Chemical softening, Demineralization, Resins used for water softening, Water for boiler use, cooling purposes, cooling towers, drinking and process water treatment, reuse and conservation of water, 27 50% water resources management, waste water treatment and disposal. 7 15

IV Steam: Steam generation and its application in chemical process plants, distribution and utilization, boilers, design of efficient steam heating systems, steam economy, condensate utilization, steam traps, their characteristics, selection and application, waste heat utilization 7 15

SECOND INTERNAL EXAMINATION

V Compressors and Vacuum Pumps: Types of compressors and vacuum pumps and their performance characteristics, Methods of vacuum development and their limitations, materials handling under vacuum, lubrication and oil removal in compressors and pumps, instrument air. 7 20

VI Refrigeration and Chilling systems. Oil heating systems, Nitrogen systems. 7 20

END SEMESTEREXAMINATION

Question Paper Pattern:

Maximum Marks: 100 Exam Duration: 3 Hours

Part A: There shall be Three questions uniformly covering Modules 1 and 2, each carrying 15 marks, of which the student has to answer any Two questions. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together. (2 x15= 30 Marks)

Part B: There shall be Three questions uniformly covering Modules 3 and 4, each carrying 15 marks, of which the student has to answer any Two questions. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together. (2 x15= 30 Marks)

Part C: There shall be Three questions uniformly covering Modules 5 and 6, each carrying 20 marks, of which the student has to answer any Two questions. At the most 4 subdivisions can be there in one main question with a total of 20 marks for all the subdivisions put together. (2 x20= 40 Marks)
Course code | Course Name | L-T-P-Credits | Year of Introduction
---|---|---|---
CH484 | FUEL CELL TECHNOLOGY | 3-0-0-3 | 2016

Prerequisite : Nil

Course Objectives
- To expose the students to the fundamental knowledge required in the development of fuel cell technology.

Syllabus

Expected Outcome
At the end of the course the students will be able to:
1. Know the fundamentals of electrochemistry, thermodynamics, fluid mechanics, and heat and mass transfer, appropriate for the design or review of components of fuel cells and fuel cell systems.
2. Analyze the fuel cell technology and compare different types of fuel cell systems.
3. Calculate the various losses in fuel cells and analyze the fuel cell power plant subsystems.
4. Defend the significance of fuel cell technology in the new global energy scenario.
5. Distinguish the expectancies of hydrogen as a fuel and energy vector in the context of renewable energy.

References Books:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. exam marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Introduction:</strong> Fuel Cell, Brief History of fuel cells, Types of Fuel Cells, Working of a PEM fuel Cell, Fuel Cell and conventional processes – comparison, Energy &amp; power relations, units, Application scenarios, Advantages and disadvantages.</td>
<td>7</td>
<td>15%</td>
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<tr>
<td>II</td>
<td>Reaction Kinetics: Electrochemical reaction fundamentals, electrode kinetics, Charge transfer and activations energy, Exchange current density - slow and fast reactions. Potential and equilibrium - galvanic potential, Reaction rate and potential - Butler Volmer equation &amp; Tafel equation, Electrocatalysts and reaction kinetics – typical exchange current densities, Electrode design basics</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>FIRST INTERNAL EXAMINATION</td>
<td>Charge and Mass Transport: Charge transport resistances, voltage losses, Ionic and electronic conductivites, Ionic conduction in different FC electrolytes: Aquesous, polymeric and ceramic, Diffusive transport &amp; voltage loss: Limiting current density, Nerstian and kinetic effect, Convective transport: flow channels, gas diffusion / porous layer, gas velocity, pressure, Flow channel configurations</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>III</td>
<td>Overview of Fuel Cell Types: PAFC, PEMFC, AFC, MCFC, SOFC. Major Cell Components, Material Properties, Processes and Operating Conditions of PEMFC.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>SECOND INTERNAL EXAMINATION</td>
<td>Stack Design: Sizing of a Fuel Cell Stack, Stack Configuration, Uniform distribution of Reactants, Heat removal, Stack Clamping Fuel Cell Diagnostics: Polarization Curve, Current Interrupt, AC Impedance Spectroscopy, Pressure drop as a diagnostic tool.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>VI</td>
<td>END SEMESTER EXAMINATION</td>
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</tr>
</tbody>
</table>
Question Paper Pattern

Maximum Marks: 100
Exam Duration: 3 Hours

Part A: There shall be Three questions uniformly covering Modules 1 and 2, each carrying 15 marks, of which the student has to answer any Two questions. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.

(2 x 15 = 30 Marks)

Part B: There shall be Three questions uniformly covering Modules 3 and 4, each carrying 20 marks, of which the student has to answer any Two questions. At the most 4 subdivisions can be there in one main question with a total of 20 marks for all the subdivisions put together.

(2 x 20 = 40 Marks)

Part C: There shall be Three questions uniformly covering Modules 5 and 6, each carrying 15 marks, of which the student has to answer any Two questions. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.

(2 x 15 = 30 Marks)
### Course Code: EC482  
#### Course Name: Biomedical Engineering  
#### L-T-P-C: 3-0-0-3  
#### Year of Introduction: 2016

**Prerequisite:** Nil

**Course Objectives:**
- To introduce basics of biomedical engineering technology
- To understand the anatomy & physiology of major systems of the body in designing equipment for medical treatments.
- To impart knowledge about the principle and working of different types of bio-medical electronic equipment/devices.

**Syllabus:**
Human body-overview, Physiological systems of body, Measurement of physiological parameters, Assisting and therapeutic devices, Medical laboratory equipments, Telemetry in patient care, Patient safety, Medical imaging system

**Expected Outcome:**
The students will be able:
- i. To understand diagnosis and therapy related equipments.
- ii. To understand the problem and identify the necessity of equipment for diagnosis and therapy.
- iii. To understand the importance of electronics engineering in medical field.
- iv. To understand the importance of telemetry in patient care

**Text Books:**

**References:**
3. John G Webster, “Medical Instrumentation application and design”, 3ed,John Wiley

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Course content</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to bio-medical instrumentation system, overview of anatomy and physiological systems of the body.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sources of bio-electric potential: Resting and action potential, propagation of action potentials. Bioelectric potentials examples (ECG, EEG, EMG, ERG, EOG, EGG, etc introduction only.)</td>
<td>2</td>
<td>15%</td>
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<tr>
<td>Section</td>
<td>Content</td>
<td>Weightage</td>
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<tr>
<td>I</td>
<td>Electrode theory: Nernst relation Bio potential electrodes: Microelectrodes, skin surface electrodes, needle electrodes.</td>
<td>1</td>
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<tr>
<td></td>
<td>Instrumentation for clinical laboratory: Bio potential amplifiers-instrumentation amplifiers, carrier amplifiers, isolation amplifiers, chopper amplifiers</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Heart and cardiovascular system (brief discussion), electro conduction system of the heart. Electrocardiography, ECG machine block diagram, ECG lead configurations, ECG recording system, Einthoven triangle, analysis of ECG signals.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Measurement of blood pressure: Direct, indirect and relative methods of blood pressure measurement, auscultatory method, oscillometric and ultrasonic non-invasive pressure measurements.</td>
<td>2</td>
<td></td>
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<tr>
<td></td>
<td>Measurement of blood flow: Electromagnetic blood flow meters and ultrasonic blood flow meters.</td>
<td>2</td>
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<tr>
<td>FIRST INTERNAL EXAM</td>
<td></td>
<td>15%</td>
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</tr>
<tr>
<td>III</td>
<td>The human nervous system. Neuron, action potential of brain, brain waves, types of electrodes, placement of electrodes, evoked potential, EEG recording, analysis of EEG.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electromyography: Nerve conduction velocity, instrumentation system for EMG.</td>
<td>1</td>
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<tr>
<td></td>
<td>Physiology of respiratory system (brief discussion), Respiratory parameters, spirometer, body plethysmographs, gas exchange and distribution.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Instruments for clinical laboratory: Oxymeters, pH meter, blood cell counter, flame photometer, spectrophotometer</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Therapeutic Equipments: Principle, block schematic diagram, working and applications of: pacemakers, cardiac defibrillators, heart–lung machine, dialyzers, surgical diathermy equipment, ventilators</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>SECOND INTERNAL EXAM</td>
<td></td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Medical Imaging systems (Basic Principle only): X-ray imaging - Properties and production of X-rays, X-ray machine, applications of X-rays in medicine.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Computed Tomography: Principle, image reconstruction, scanning system and applications.</td>
<td>2</td>
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<tr>
<td></td>
<td>Ultrasonic imaging systems: Basic pulse echo system, propagation of ultrasonic through tissues and reflections, display types, A-Scan, B-Scan, M-Scan, applications, real-time ultrasonic imaging systems and probes.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Magnetic Resonance Imaging – Basic NMR components, Biological effects and advantages of NMR imaging</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
Biomedical Telemetry system: Components of biotelemetry system, application of telemetry in medicine, single channel telemetry system for ECG and temperature  
Patient Safety: Electric shock hazards, leakage current, safety codes for electro medical equipments

END SEMESTER EXAM

Question Paper Pattern (End semester exam)

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 100% for theory.
Course code. | Course Name | L-T-P - Credits | Year of Introduction |
---|---|---|---|
EE482 | ENERGY MANAGEMENT AND AUDITING | 3-0-0-3 | 2016 |

Prerequisite: NIL

Course Objectives
- To enable the students to understand the concept of energy management
- To understand the different methods used to control peak demand
- To understand the energy management opportunities in different systems
- To understand how the use of energy audit.
- To understand the different methods used for the economic analysis of energy projects

Syllabus

Expected outcome.
The students will be able to:

i. Understand the different methods used to reduce energy consumption
ii. Know energy audit
iii. Do economic analysis of energy projects

Text Book/References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>General principles of Energy management and Energy management planning. Peak Demand controls, Methodologies, Types of Industrial Loads, Optimal Load scheduling-Case studies</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Energy management opportunities in Lighting and Motors. Electrolytic Process and Electric heating, Case studies</td>
<td>8</td>
<td>15%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAMINATION
<table>
<thead>
<tr>
<th>Module</th>
<th>Topics</th>
<th>Questions</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Types of boilers, Combustion in boilers, Performances evaluation, Feed water treatment, Blow down, Energy conservation opportunities in boiler. Properties of steam, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Identifying opportunities for energy savings. Classification, General fuel economy measures in furnaces, Excess air, Heat Distribution, Temperature control, Draft control, Waste heat recovery.</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Energy audit -Definition, Need, Types of energy audit, Energy audit Instruments. Cogeneration-Types and Schemes, Optimal operation of cogeneration plants- Case study. Computer aided energy management.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Economic analysis methods-cash flow model, time value of money, evaluation of proposals, pay-back method, average rate of return method, internal rate of return method, present value method, life cycle costing approach, Case studies.</td>
<td>6</td>
<td>20%</td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>Module</th>
<th>Topics</th>
<th>Questions</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Energy audit -Definition, Need, Types of energy audit, Energy audit Instruments. Cogeneration-Types and Schemes, Optimal operation of cogeneration plants- Case study. Computer aided energy management.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Economic analysis methods-cash flow model, time value of money, evaluation of proposals, pay-back method, average rate of return method, internal rate of return method, present value method, life cycle costing approach, Case studies.</td>
<td>6</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100 Exam Duration: 3Hrs.

**Part A:** 8 compulsory questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

**Part B:** 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10)=20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

**Part C:** 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10)=20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

**Part D:** 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10)=20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P-C</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE484</td>
<td>Control Systems</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite : NIL

**Course Objectives**
- To give the knowledge of Mathematical model of physical systems.
- To impart knowledge of different control equipment.
- To provide knowhow of analysing systems with mathematical model.

**Syllabus**
Linear Time Invariant systems: Open loop and closed loop control systems, Transfer function: Mechanical, Electromechanical systems; block diagram representation, signal flow graph. Control system components. Time domain analysis of control systems. PID controllers, Concept of stability, Frequency domain analysis, Introduction to Statespace.

**Expected outcome.**
The students will have the
i. Concept of modelling in transfer function and state space domain
ii. Ability to analyse stability of linear time invariant systems.

**Text Books:**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Open loop-and closed loop control systems: Transfer function - T.F of simple linear time invariant systems - Mechanical and Electromechanical systems – Force voltage and force current analogy - block diagram representation - blockdiagram reduction - signal flow graph - Mason's gain formula - characteristics equation.</td>
<td>9</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Control system components: DC and AC servo motor – synchro - magnetic amplifier - gyroscope - stepper motor - Tacho meter.</td>
<td>5</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

| III    | Time domain analysis of control systems: Transient and steady state responses - test signals - time domain specifications - first and second order systems - impulse and step responses - steady state error analysis - static error coefficient of type 0,1,2 systems - Dynamic error coefficients | 7     | 15%                 |

| IV     | PID controllers, Concept of stability: stability of feedback system - Routh's stability criterion - Root locus - General rules for constructing Root loci - effect of addition of poles and zeros. | 7     | 15%                 |

**SECOND INTERNAL EXAMINATION**

| V      | Frequency domain analysis: Introduction - Bode plot-Polar plot- | 6     | 20%                 |
gain margin - phase margin.

| VI | Introduction to state space: State concept, state equation of simple systems, physical and phase variables, Eigen value and eigenvectors, conversion of state space model to transfer function. | 8 | 20% |

END SEMESTER EXAM

QUESTION PAPER PATTERN:

Maximum Marks: 100  
Exam Duration: 3Hrs.

Part A: 8 compulsory questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.
Course code | Course Name | L-T-P-C | Year of Introduction
---|---|---|---
EE486 | SOFT COMPUTING | 3-0-0-3 | 2016

Prerequisite: NIL

Course Objectives
- To provide the concepts of soft computing techniques such as neural networks, fuzzy systems, genetic algorithms

Syllabus
Introduction To Soft Computing And Neural Networks, Fuzzy Sets And Fuzzy Logic: Fuzzy Sets, Neuro-Fuzzy Modelling, Machine Learning, Machine Learning Approach to Knowledge Acquisition

Expected outcome.
The students will be able to get ideas on:
1. Artificial Intelligence, Various types of production systems, characteristics of production systems.
2. Neural Networks, architecture, functions and various algorithms involved.
4. Genetic algorithms, its applications and advances

Text Books:

References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction To Soft Computing And Neural Networks : Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Adaptive Networks – Feed forward Networks – Supervised Learning</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAMINATION
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</thead>
<tbody>
<tr>
<td>IV</td>
<td>Data Clustering Algorithms – Rulebase Structure Identification Neuro-Fuzzy Control.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td><strong>SECOND INTERNAL EXAMINATION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Applications of GA in Machine Learning - Machine Learning Approach to Knowledge Acquisition. Support Vector Machines for Learning – Linear Learning Machines – Support Vector Classification – Support Vector Regression - Applications.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td><strong>END SEMESTER EXAM</strong></td>
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<tr>
<td><strong>QUESTION PAPER PATTERN:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Marks: 100</td>
<td>Exam Duration: 3Hrs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Part A:</strong></td>
<td>8 compulsory questions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One question from each module of Module I - IV; and two each from Module V &amp; VI.</td>
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<td></td>
</tr>
<tr>
<td>Student has to answer all questions. (8 x5)=40</td>
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</tr>
<tr>
<td><strong>Part B:</strong></td>
<td>3 questions uniformly covering Modules I &amp; II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.</td>
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</tr>
<tr>
<td><strong>Part C:</strong></td>
<td>3 questions uniformly covering Modules III &amp; IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.</td>
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<tr>
<td><strong>Part D:</strong></td>
<td>3 questions uniformly covering Modules V &amp; VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.</td>
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<tr>
<td>Course code</td>
<td>Course Name</td>
<td>L-T-P -C</td>
<td>Year of Introduction</td>
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<tr>
<td>EE488</td>
<td>INDUSTRIAL AUTOMATION</td>
<td>3-0-0-3</td>
<td>2016</td>
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</tbody>
</table>

Prerequisite: NIL

**Course Objectives**
- Explain the General function of Industrial Automation
- Identify Practical Programmable Logic Controller Applications
- Identify Types of Industrial Sensors
- Explain Robotics

**Syllabus**
Types of motion actuators, electrical and mechanical sensors, ladder diagrams, cascade method, Huffman method, Programmable Logic Controllers, Microcomputers: interfacing and programming, Principles of Robotics and applications

**Expected outcome.**
The students will be able to
i. Know about motion devices and various in automation
ii. Draw ladder diagrams for applications
iii. Understand assembly language programs
iv. Know about Robotic components

**Text Book:**
1. Pessen, Industrial Automation: Circuit Design and Components, Wiley

**References:**
1. Bartelt, Industrial Automated Systems, Instrumentation and Motion Control, Cengage
2. Mukhopadyay et al., Industrial Instrumentation, Control and Automation, Jaico Publishing House

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Motion Actuators: Types of Motion and Motion Conversion, Electric Linear Actuators, Electric Rotary Actuators, Fluid-Power Linear Actuators, Fluid-Power Rotating Actuators</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Sensors: Binary vs. analog sensors, Electric Position sensors: Limit switches, photovoltaic sensors, ultrasonic sensors, inductive and capacitive and magnetic proximity sensors, Pneumatic position sensors: limit valves, back-pressure sensors, coiled spring sensors. Level, pressure, temperature and flow switches</td>
<td>6</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

| III    | Electric Ladder Diagrams: Ladder diagrams, sequence charts, Ladder diagram design using sequence charts, cascade method, single and multi path sequencing systems with and without sustained outputs, Huffman method: sequential systems, stable and unstable states, state assignment. | 6     | 15%                 |
| IV     | Programmable Controllers: PLC construction, Programming the PLC, constructing ladder diagrams for PLCs, | 6     | 15%                 |

**SECOND INTERNAL EXAMINATION**
END SEMESTER EXAM

QUESTION PAPER PATTERN:

Maximum Marks: 100
Exam Duration: 3Hrs.

Part A: 8 compulsory questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.
Course code: EE494
Course Name: Instrumentation Systems
L-T-P-C: 3-0-0-3
Year of Introduction: 2016
Prerequisite: NIL

Course Objectives
- To introduce the measurement techniques of force, torque, speed, pressure, flow & temperature.
- To introduce different types of electronic circuits for measurements and their applications.

Syllabus

Expected outcome.
The students will be able to
i. Understand and analyze Instrumentation systems.
ii. Select proper measurement system for various applications.

Text Book:

References:
2. Turner and Hill, Instrumentation for Engineers and Scientists, Oxford University Press, 1999

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Shaft Power Measurements: Shaft Power Measurements (Dynamometers), Vibrating-Wire Force Transducers</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>Module</td>
<td>Topics</td>
<td>Marks</td>
<td>Percentage</td>
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<tr>
<td>IV</td>
<td>Pressure and Sound Measurements: Standards and Calibration, Basic Methods of Pressure Measurements, Deadweight Gages and Manometers, Elastic Transducers, Vibrating-Cylinder and Other Resonant Transducers</td>
<td>6</td>
<td>15%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

- **Maximum Marks: 100**
- **Exam Duration: 3Hrs.**

**Part A:** 8 compulsory questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x 5) = 40

**Part B:** 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) = 20. Each question can have maximum of 4 sub questions (a, b, c, d), if needed.

**Part C:** 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) = 20. Each question can have maximum of 4 sub questions (a, b, c, d), if needed.

**Part D:** 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) = 20. Each question can have maximum of 4 sub questions (a, b, c, d), if needed.
Course code | Course Name | L-T-P -Credits | Year of Introduction
--- | --- | --- | ---
FS482 | RESPONSIBLE ENGINEERING | 3-0-0-3 | 2016

Prerequisite : Nil

Course Objectives
- To enable the students to create an awareness on responsibilities and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

Syllabus

Expected outcome.
- The students will be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society

Text Books:

Data Book (Approved for use in the examination): Nil

References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>HUMAN VALUES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>ENGINEERING ETHICS</td>
<td></td>
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</tbody>
</table>

FIRST INTERNAL EXAMINATION
### III
**ENGINEERING AS SOCIAL EXPERIMENTATION**  
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

### IV
**ENGINEER’S RESPONSIBILITY FOR SAFETY**  

### V
**RESPONSIBILITIES AND RIGHTS**  

### VI
**GLOBAL ISSUES**  

### END SEMESTER EXAM

**QUESTION PAPER PATTERN**

Maximum Marks: 100  
Exam Duration: 3 hours

**Part A** – 8 questions (Module 1 to 4 one question each, Module 5 & 6 two questions each) of 2 marks each. All questions are compulsory  
\( (8 \times 2 = 16) \)

**Part B** – 8 questions (Module 1 to 4 one question each, Module 5 & 6 two questions each) of 3 marks each. All questions are compulsory  
\( (8 \times 3 = 24) \)

**Part C** – 12 questions (two questions from each module) of 10 marks each. Student has to answer one question from each module.  
\( (6 \times 10 = 60) \)

**Note:** Each question can have a maximum of 4 sub parts, if needed.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>FT482</td>
<td>Food Process Engineering</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**
- To introduce different thermal and non-thermal food processing principles.

**Syllabus**
Raw material Preparation, Blanching, Pasteurization, Sterilization, Size reduction, Drying, Psychrometry, Refrigeration, Baking, Frying, Extrusion, Sedimentation, Centrifugation, Minimal Processing, Packaging, Cleaning

**Expected outcome.**
- The students will gain knowledge on various food processes like pasteurization, drying, refrigeration, centrifugation etc.

**Text Books:**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Raw material Preparation and Thermal processing:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Food process, Raw material properties, physical, functional, preparation; Cleaning; wet and dry, Peeling methods, sorting and grading, Blanching, Pasteurization, HTST, LTLT, UHT, pasteurizers, microbial inactivation, F, D, Z values</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Size Reduction:</strong></td>
<td></td>
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<tr>
<td></td>
<td>Size reduction of solids, principles, laws of size reduction, kicks.</td>
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<tr>
<td></td>
<td>Bond, rittinger, equipment; roller mill, impact mill, attrition mill, tumbling mills, methods, particle size distribution, energy consumption, homogenization</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td><strong>FIRST INTERNAL EXAMINATION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td><strong>Drying and Psychrometry:</strong></td>
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<tr>
<td></td>
<td>water activity, moisture content, drying rate curve,EMC, isotherms, Driers;Tray, tunnel, puff, fluidized bed, spray. Rotary drier etc. Freeze dryingDrying time prediction. Dehydrated productsRehydration</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>Characteristics</td>
<td>Psychrometry, basic principles, psychrometric chart, terms, numerical solving</td>
<td></td>
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<td></td>
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<tr>
<td><strong>IV</strong></td>
<td>Refrigeration: Methods, equipment, VA, VC refrigeration systems, components; compressor, condenser, evaporator, refrigerant, COP Chilling and freezing, freezing kinetics-models, effect of low temperature on food spoilage, prediction of freezing time; Plank’s, Pham’s method, thawing, Frozen food storage, freezer types. Refrigerated transportation; land, marine, air transportation Precooling methods</td>
<td></td>
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<tr>
<td></td>
<td>7 15%</td>
<td></td>
<td></td>
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<tr>
<td><strong>SECOND INTERNAL EXAMINATION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>V</strong></td>
<td>Baking and Frying process Baking Process, Frying process- principle, heat and mass transfer, machinery, products, frying oils, kinetics of oil uptake Extrusion, principle, extruded products Sedimentation and centrifugation; principle, basic equations, settling tank, baffled. Centrifugation, tubular, disc bowl, decanter, basket centrifuge</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>7 20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VI</strong></td>
<td>Minimal processing: Ohmic heating, RF heating, Pulsed Electric field heating, High pressure processing, Food Irradiation, Ultrasound, Hurdle Technology Food filling and packaging systems, packaging materials, CAP, MAP, Vacuum</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>7 20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>END SEMESTER EXAM</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Question paper pattern:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum marks: 100</td>
<td>Exam Duration: 3 hours</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The question paper shall consist of three parts.

**Part A**: Three questions of 15 marks each uniformly covering modules 1 & 2. The students have to answer any two full questions. Each question can have maximum of 4 sub questions.

**Part B**: Three questions of 15 marks each uniformly covering modules 3 & 4. The students have to answer any two full questions. Each question can have maximum of 4 sub questions.

**Part C**: Three questions of 20 marks each uniformly covering modules 5 & 6. The students have to answer any two full questions. Each question can have maximum of 4 sub questions.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>FT484</td>
<td>Food Storage Engineering</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite : Nil

Course Objectives
- To introduce different storage mechanisms for food.

Syllabus
Traditional and modern storage structures, Silos, warehouses, cold storages, Storage of raw and processed foods, Supporting equipments; dryers, freezers etc.

Expected outcome.
Student will have knowledge on various food storage structures and mechanisms

Text Books:

References:
3. Himangshu Barman, Post Harvest Food Grain Storage, Agrobios (India), 2008

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction: Food and grain storage, introduction, scope, importance, basic requirements, safe and scientific storage. Selection of site for storage, pre and post storage operations; cleaning, drying, inspection etc., spoilage, control measures</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Traditional and small scale storage: Traditional storage methods, mud bin, drums, gunny bags etc., small scale storage structures, brick, concrete types, Local storage, morai, bhukari, kothar, kuthla structures, improved storage; bunker, cover and plinth, Factors affecting storage</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Modern and large scale storage: Bulk storage, warehouses; considerations, types. Silos; types- deep, shallow, Airys, Janseens equations, numericals</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Refrigerated storage:</td>
<td>7</td>
<td>15%</td>
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<tr>
<td>------------</td>
<td>----------------------------------------------------------------------------------------</td>
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<tr>
<td></td>
<td>Cold storage, refrigeration load calculations, cold storage components, vapour barriers,</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>V</th>
<th>Storage of food</th>
<th>7</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frozen storage, CAS, MAS, hermetic storage, Storage conditions for raw and processed fruits, vegetables, meat, dairy etc. Storage requirements</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VI</th>
<th>Supporting structure :</th>
<th>7</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Supporting equipment; Drying before storing, dryers, humidifier, dehumidifier, freezers, conveyors for solid and liquid food storage. Aeration, ventilation Economic aspects of storage.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**Question paper pattern:**

Maximum marks: 100  
Exam Duration: 3 hours

The question paper shall consist of three parts.

**Part A**: Three questions of 15 marks each uniformly covering modules 1 & 2. The students have to answer any two full questions. Each question can have maximum of 4 sub questions.

**Part B**: Three questions of 15 marks each uniformly covering modules 3 & 4. The students have to answer any two full questions. Each question can have maximum of 4 sub questions.

**Part C**: Three questions of 20 marks each uniformly covering modules 5 & 6. The students have to answer any two full questions. Each question can have maximum of 4 sub questions.
Course code | Course Name | L-T-P - Credits | Year of Introduction
--- | --- | --- | ---
FT486 | Food Additives and Flavourings | 3-0-0-3 | 2016

Prerequisite: Nil

Course Objectives
- To know the role and activity of chemical and natural food additives.

Syllabus
Food additives and their permissible limits, Additives used for colouring preservation, Antioxidants, Additives for emulsification, stabilization, Acidulants sweeteners, Flavouring agents, Sensory valuation

Expected outcome.
- The students will get knowledge of food additives and their permissible limits

Text Books:

References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction: Food Additives- definition, intentional and incidental additives, evaluation of additives, maximum permissible limit, methods for finding tolerance limits, approval of food additive, Risk assessment, levels of toxicity, acute and chronic studies, government regulations with respect to additives</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Additives used in food preservation and processing</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>---</td>
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<td>---</td>
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</tr>
<tr>
<td>Additives used in food preservation and processing preservative, antioxidants, colouring agents: functions, chemistry, mode of action, uses in food formulations</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>III</th>
<th>Emulsifiers, Stabilizers:</th>
<th>7</th>
<th>15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emulsifiers, Stabilizers, Ant caking agents, Enzymes, Gases.: Function and Applications, mode of action, chemistry, physical and chemical properties, permissible level in foods</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IV</th>
<th>Acidulants, Sweeteners:</th>
<th>7</th>
<th>15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidulants, Sequestrants, Sweeteners, Nutritive additives: Function and Applications, Safety issues, mode of action, chemistry, physical and chemical properties, permissible level in foods</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>V</th>
<th>Sensory instruments</th>
<th>8</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Flavour, its importance, substances responsible for flavour, flavour isolation methods, essential oil, oleoresins, spray dried products, different flavour products, extracts, essences, flavour emulsions, flavour analysis(GC, Electronic Nose), scoville unit</td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VI</th>
<th>Flavouring agents</th>
<th>7</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavouring agents used in food industry, natural, natural identical and artificial flavouring agents, process flavour, flavour enhancer/modifier, commonly used flavouring agents in food</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**Question paper pattern:**

Maximum marks:100  Exam Duration : 3 hours

The question paper shall consist of three parts.

**Part A** : Three questions of 15 marks each uniformly covering modules 1 & 2. The students have to answer any two full questions. Each question can have maximum of 4 sub questions.

**Part B** : Three questions of 15 marks each uniformly covering modules 3 & 4. The students have to answer any two full questions. Each question can have maximum of 4 sub questions.

**Part C** : Three questions of 20 marks each uniformly covering modules 5 & 6. The students have to answer any two full questions. Each question can have maximum of 4 sub questions.
Course code | Course Name | L-T-P-C | Year of Introduction |
-------------|-------------|---------|----------------------|
IC482        | BIOMEDICAL SIGNAL PROCESSING | 3-0-0-3 | 2016                |

Prerequisite: NIL

Course Objectives
- To study various biomedical signals and their data reduction
- To learn frequency domain and time series analysis of biomedical signals
- To study spectral estimation of biomedical signals
- To study event detection and waveform analysis

Syllabus
Introduction to biomedical signals- ECG analysis – Data reduction – Signal averaging-
Frequency domain analysis-Time series analysis- Spectral analysis- Event detection and
waveform analysis.

Expected Outcome
The students will be able to
- Visualise difficulties involved in biomedical signal processing
- Do time series and frequency domain analysis of biomedical signals
- Conduct spectral estimation of biomedical signals
- Perform event detection and waveform analysis of biomedical signals

References
1. Arnon Cohen, Biomedical Signal Processing Time and Frequency Domains Analysis
   (Volume I), CRC press.
2. D.C.Reddy, Biomedical Signal Processing Principles and Techniques, Tata Mc Graw-
   Hill
3. Rangaraj M Rangayyan, Biomedical Signal Analysis A case study approach, John
   Wiley publications.
4. Willis J. Tompkins, Biomedical Digital Signal Processing, PHI.

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Introduction:</strong> Introduction to biomedical signals, Biomedical signal acquisition and processing, Difficulties in signal acquisition</td>
<td>4</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td><strong>ECG:</strong> ECG signal origin, ECG parameters-QRS detection different techniques, ST segment analysis, Arrhythmia, Arrhythmia analysis, Arrhythmia monitoring system.</td>
<td>6</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAM**

<p>| III    | <strong>ECG Data Reduction:</strong> Direct data compression Techniques: Turning Point, AZTEC, Cortes, FAN, Transformation Compression Techniques: Karhunen - Loeve Transform, Other | 8     | 15% |</p>
<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>Description</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>Data compression Techniques</td>
<td>DPCM, Huffman coding, Data compression Techniques comparison. <strong>Signal averaging:</strong> Basics of signal averaging, Signal averaging as a digital filter, A typical averager, Software and limitations of signal averaging.</td>
<td>8</td>
</tr>
<tr>
<td>IV</td>
<td>Frequency Domain Analysis</td>
<td>Introduction, Spectral analysis, linear filtering, cepstral analysis and homomorphic filtering, Removal of high frequency noise (power line interference), motion artifacts (low frequency) and power line interference in ECG.</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Event Detection and waveform analysis</td>
<td>Need for event detection, Detection of events &amp; waves, Correlation analysis of EEG signals, The matched filter, Detection of the P wave, Identification of heart sounds, Morphological analysis of ECG waves, analysis of activity.</td>
<td>7</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3 Hours

**Part A**

Answer any two out of three questions from Module 1 and 2 together. Each question carries 15 marks and can have not more than four sub divisions. (15 x 2 = 30 marks)

**Part B**

Answer any two out of three questions from Module 3 and 4 together. Each question carries 15 marks and can have not more than four sub divisions. (15 x 2 = 30 marks)

**Part C**

Answer any two out of three questions from Module 5 and 6 together. Each question carries 20 marks and can have not more than four sub divisions. (20 x 2 = 40 marks)
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>IE482</td>
<td>FINANCIAL MANAGEMENT</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite : Nil

**Course Objectives:**
- To build an understanding of concepts, vital tools and techniques applicable for financial decision-making by a business firm.
- To understand the use of basic financial management concepts.
- To become familiar with the various types of financing available to a firm.

**Syllabus:**

**Expected outcome.**
The students will be able to
- Obtain an overview of financial system.
- Analyze financial statements using standard financial ratios.
- Apply techniques to project financial statements for forecasting long-term financial needs.
- Understand the role of short-term financial needs.
- Apply time value, risk, and return concepts.

**Text books**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Nature and Scope of Financial Management; Financial Objectives; goal of financial management, FM decisions, Time Value of Money.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Funds Flow Analysis; Cash Flow Statement and its Interpretation, Financial Statement Analysis, Ratio Analysis, Time Series.</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAMINATION
<table>
<thead>
<tr>
<th>III</th>
<th>Planning for Sources of Finance; Capital Structure; Net Income Approach; Net Operating Income Approach; Traditional Approach and MM Approach, Cost of Capital; EBIT – EPS Analysis, Capital Gearing/Debt-Equity Ratio</th>
<th>7</th>
<th>15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>Retained Earning Vs. Dividend Decision; Gordon Model; Walter Model; MM Approach; Fixed and Current, Short-term financial planning.</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>V</th>
<th>Working capital–Gross and net working capital, planning and management, Operating Cycle, Determination of working capital.</th>
<th>7</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI</td>
<td>Capital Budgeting – Evaluation techniques for capital budgeting, capital budgeting decision criteria, NPV–IRR comparisons, capital rationing.</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

End Semester Examination Question Paper Pattern:

Examination duration: 3 hours  
Maximum Marks: 100

**Part A (Modules I and II):**

Candidates have to answer any 2 questions from a choice of 3 questions. Each full question carries a total of 15 marks and can have a maximum of 4 sub questions (a, b, c, d). No two full questions shall be exclusively from a single module. All three questions shall preferably have components from both modules. Marks for each question/sub question shall be clearly specified. Total percentage of marks for the two modules put together as specified in the curriculum shall be adhered to for all combinations of any two questions.

**Part B (Modules III and IV):** (Same as for part A marks)

**Part C (Modules V and VI):**

(Same as for part A, except that each full question carries 20 marks)

**Note:** If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE484</td>
<td>INTRODUCTION TO BUSINESS ANALYTICS</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite : Nil

Course Objectives:
- To know how the use of business analytics to formulate and solve business problems and to support managerial decision making.
- To familiarize the practices needed to develop, report, and analyze business data.

Syllabus:
**Descriptive Analytics** - Visualizing and Exploring Data, Descriptive Statistical Measures, Probability Distributions and Data Modeling, Sampling and Estimation, Statistical Inference

**Predictive Analytics** - Trend lines and Regression Analysis, Forecasting Techniques, Introduction to Data Mining, Monte Carlo Simulation and Risk Analysis

**Prescriptive Analytics** - Linear Programming Problem-Formulation, Solution methods; Transportation Problem-Formulation and solution; Assignment Problem- Formulation and solution; Dynamic Programming problem; Integer Programming Problem- Formulation and solution.

Expected outcome:
The students will:
- i. gain the knowledge of fundamental concepts and tools needed to understand the emerging role of business analytics in organizations.
- ii. be able to apply basic business analytics tools, interpret analytic models and results for making better business decisions.

References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to Business Analytics-Evolution, Scope, Models Bruscriptive Analytics- Data Visualization, Statistical Methods for Summarizing Data, Measures of Central Tendency, Measures of Dispersion, Measures of Shape, Measures of Association, Probability Distributions and Data Modeling; Discrete and Continuous Probability Distributions, Random Sampling from Probability Distributions, Data Modeling and Distribution Fitting</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Predictive Analytics- Modeling Relationships and Trends in Data, Simple Regression and Correlation: Introduction, Estimation using the regression line, Correlation Analysis. Multiple Regression: The k-variable multiple regression model, The F-test of a Multiple Regression model.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Forecasting Techniques- Qualitative and Judgmental Forecasting, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality Introduction to Data Mining, Monte Carlo Simulation and Risk Analysis.</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAMINATION**

| V | Prescriptive Analytics - Linear Programming Problem- Formulation, Graphical solutions, Simplex method, Revised Simplex method and Sensitivity Analysis; Transportation Problem- Formulation and solution; Assignment Problem- Formulation and solution | 7 | 20% |
| VI | Deterministic Dynamic Programming problem Bellman’s principle of optimality - computational procedure for Shortest Route problem, Reliability Problem, Equipment Replacement Problem etc; Integer Programming Problem- Formulation, Branch and Bound algorithm, Cutting Plane Algorithm | 7 | 20% |

**END SEMESTER EXAM**

End Semester Examination Question Paper Pattern:

- Examination duration: 3 hours
- Maximum Marks: 100

**Part A (Modules I and II):**

Candidates have to answer any 2 questions from a choice of 3 questions. Each full question carries a total of 15 marks and can have a maximum of 4 sub questions (a, b, c, d). No two full questions shall be exclusively from a single module. All three questions shall preferably have components from both modules. Marks for each question/sub question shall be clearly specified. Total percentage of marks for the two modules put together as specified in the curriculum shall be adhered to for all combinations of any two questions.

**Part B (Modules III and IV):** (Same as for part A marks)

**Part C (Modules V and VI):** (Same as for part A, except that each full question carries 20 marks)

**Note:** If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.
**Course Code**: IE486  
**Course Name**: DESIGN AND ANALYSIS OF EXPERIMENTS  
**L-T-P - Credits**: 3-0-0-3  
**Year of Introduction**: 2016

Prerequisite : Nil

**Course Objectives:**
- To introduce the concept of experimentation
- To equip students to understand the necessity of experimentation
- To provide basic methods of designing an experiment

**Syllabus:**
Statistical fundamentals, hypothesis testing, analysis of variance, block design, statistical analysis of models, full factorial and fractional factorial designs, introduction to Taguchi method.

**Expected outcome**:
The students will be able to:
- Understand the need for a design for experimentation
- Apply the basic principles to do an experiment design
- Make inferences out of the outcomes of experimental design.

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Basic Statistical Concepts, sampling and sampling distributions, comparisons of populations by sample statistics – known populations parameters and unknown population parameters, paired comparisons</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Importance of experiments, experimental strategies, basic principles of design, terminology, steps in experimentation, sample size, normal probability plot, linear regression model.</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

| III    | Hypothesis testing – z-test, t-test, chi-square test and F-test, Single factor experiments – ANOVA, model adequacy testing | 7     | 15%                 |
| IV     | Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy testing and interpretation of results | 7     | 15%                 |

**SECOND INTERNAL EXAMINATION**

| V      | Two and three factor full factorial experiments, $2^k$ factorial Experiments, confounding and Blocking designs. | 7     | 20%                 |
| VI     | Fractional factorial designs, Introduction to Response Surface Methodology, theory of experiments with random factors, | 7     | 20%                 |
introduction to Taguchi design method.
Use of software packages in design of experiments.

END SEMESTER EXAM

Question Paper Pattern:

Examination duration: 3 hours
Maximum Marks: 100

Part A (Modules I and II):
Candidates have to answer any 2 questions from a choice of 3 questions. Each full question carries a total of 15 marks and can have a maximum of 4 sub questions (a, b, c, d). No two full questions shall be exclusively from a single module. All three questions shall preferably have components from both modules. Marks for each question/sub question shall be clearly specified. Total percentage of marks for the two modules put together as specified in the curriculum shall be adhered to for all combinations of any two questions.

Part B (Modules III and IV): (Same as for part A marks)

Part C (Modules V and VI):
(Same as for part A, except that each full question carries 20 marks)

Note: If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.
Course Objectives:
- To impart knowledge on principles and practices of TQM to achieve quality.
- To enable use of TQM tools for continuous quality improvement.
- To provide ideas on implementation of quality standards.
- To introduce the latest TQM tools and techniques.

Syllabus:
Introduction to quality, Contributions of quality Gurus, Quality control tools, Cost of Quality, Taguchi loss function, Basic concepts of TQM, Principles of Total Quality Management, Total quality control, Quality assurance, Vendor rating, Quality improvement programmes, Quality planning, Quality function deployment, Six sigma approach, Failure mode & effect analysis, TPM, BPR, Quality standards.

Expected outcome:
The students will be able to
- Understand the principles and practices of TQM.
- Use various TQM tools for continuous quality improvement.
- Implement quality standards.
- Become aware of the latest TQM tools and techniques.

References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction-Need for quality, Definition of quality, Major contributions of Deming, Juran and Crossby to Quality Management, Quality control tools, Cost of Quality, Taguchi loss function.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Basic concepts of Total Quality Management - Evolution of TQM, TQM framework, Barriers to TQM, Principles of Total Quality Management- Quality statements, Customer focus, Customer orientation,</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>Module</td>
<td>Topics</td>
<td>Marks</td>
<td>Weightage</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------</td>
<td>-----------</td>
</tr>
<tr>
<td>III</td>
<td>Quality assurance- Total quality assurance, Management principles in quality assurance, Objectives of quality assurance system, Hierarchical planning for Quality Assurance, Vendor rating, Quality improvement: elements, programmes, KAIZEN, PDCA cycle, 5S, Quality circles.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Quality planning- SWOT analysis, Strategic planning, strategic grid, organizational culture, Total Quality Culture, Quality function deployment- QFD concept, the voice of customer, developing a QFD matrix, QFD process.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Six sigma approach- Methodology, Training, application to various industrial situations, Failure mode &amp; effect analysis- Concepts, Types &amp; Applications in TQM.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>TPM Concepts, Improvement needs, Performance measures, BPR, Quality standards – Need of standardization, ISO 9000 series, ISO 14000 series, Other contemporary standards.</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**Question Paper Pattern:**

Examination duration: 3 hours

Maximum Marks: 100

**Part A (Modules I and II):**
Candidates have to answer any 2 questions from a choice of 3 questions. Each full question carries a total of 15 marks and can have a maximum of 4 sub questions (a, b, c, d). No two full questions shall be exclusively from a single module. All three questions shall preferably have components from both modules. Marks for each question/sub question shall be clearly specified. Total percentage of marks for the two modules put together as specified in the curriculum shall be adhered to for all combinations of any two questions.

**Part B (Modules III and IV):** (Same as for part A marks)

**Part C (Modules V and VI):** (Same as for part A, except that each full question carries 20 marks)

**Note:** If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.
<table>
<thead>
<tr>
<th>Course code.</th>
<th>Course Name</th>
<th>L-T-P -C</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT482</td>
<td>Information Storage Management</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** NIL

**Course Objectives**
- To understand data creation and the amount of data being created
- To impart the value of data to a business, challenges in data storage and data management,
- To introduce solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities

**Syllabus**
Storage system architecture, Networked storage, Information availability and monitoring a data center, remote data replication technologies, securing storage and storage virtualization,

**Expected outcome.**
The students will understand the concept of data storage in distributed environment in data center, challenges in data storage and management technologies.

**Text Books:**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Data, Information, Evolution of storage architecture, Data center infrastructure, Information lifecycle, Overview: Virtualization - Cloud, Data center environment: Application - Desktop - Memory virtualization - Connectivity - Disk drive interface</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Storage media - Flash drives, RAID: Implementation - Methods - Levels, Intelligent storage system</td>
<td>5</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

<p>| III    | Introduction to DAS and SCSI, SAN: Evolution - Components - Connectivity options - Ports - FC architecture - Zoning - FC topologies, SAN based virtualization: Block level - VSAN, IP SAN: iSCSI - FCIP components - FCIP topology and frame structure, FCOE: Components – Benefits | 7     | 15%                 |
| IV     | NAS: Benefits – Components - Implementations - File sharing             | 7     | 15%                 |</p>
<table>
<thead>
<tr>
<th>Modules</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocols - I/O operations - Factors affecting NAS performance - File level virtualization, Object based storage: Operation Benefits - Fixed content and archives - Archive types, CAS: Architecture - Operations - Use cases, Unified storage</td>
<td></td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>Module</th>
<th>Topics</th>
</tr>
</thead>
</table>

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN**

Maximum Marks: 100  
Exam Duration: 3 hours

The question paper shall consist of Part A, Part B and Part C.

**Part A** shall consist of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer any two questions (15×2=30 marks).

**Part B** shall consist of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer any two questions (15×2=30 marks).

**Part C** shall consist of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer any two questions (20×2=40 marks).

**Note**: Each question can have a maximum of 4 subparts, if needed.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME471</td>
<td>Optimization Techniques</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite - ME372 Operations Research

**Course Objective:**
- To learn the various optimization techniques for effective decision making.

**Syllabus:**

**Expected Outcome:**
- The students will be able to understand optimization techniques and apply them in solving practical problems.

**Text Books:**


**Reference Books:**


**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Review of linear programming– revised simplex method</td>
<td>1</td>
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<tr>
<td></td>
<td>Dual simplex method</td>
<td>1</td>
<td></td>
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<tr>
<td>Section</td>
<td>Topic</td>
<td>Weight</td>
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<td>---------</td>
<td>----------------------------------------------------------------------</td>
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<tr>
<td>II</td>
<td>Sensitivity analysis – changes affecting feasibility – changes affecting optimality</td>
<td>1.0</td>
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<tr>
<td></td>
<td>Integer programming – importance – applications</td>
<td>1.0</td>
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<tr>
<td></td>
<td>Branch and bound technique</td>
<td>1.0</td>
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<tr>
<td></td>
<td>Gomory’s cutting plane method</td>
<td>1.0</td>
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<tr>
<td></td>
<td>Solution to travelling salesman problem</td>
<td>1.0</td>
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<tr>
<td>III</td>
<td>Network models – minimal spanning tree problem</td>
<td>1.0</td>
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<tr>
<td></td>
<td>PRIM’s algorithm</td>
<td>1.0</td>
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<td></td>
<td>Kruskal’s algorithm</td>
<td>1.0</td>
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<tr>
<td></td>
<td>Shortest route problem – applications</td>
<td>1.0</td>
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<td>Systematic method</td>
<td>1.0</td>
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<td></td>
<td>Dijkstra’s algorithm</td>
<td>1.0</td>
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<td></td>
<td>Floyd’s algorithm</td>
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<tr>
<td>IV</td>
<td>Goal programming – goal programming formulation-application.</td>
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<tr>
<td></td>
<td>Simplex method for solving goal programming</td>
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<tr>
<td></td>
<td>Dynamic programming – terminologies – forward and backward recursion – applications</td>
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<td></td>
<td>Shortest path problems</td>
<td>1.0</td>
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<tr>
<td>V</td>
<td>Nonlinear programming – convex, quasi-convex, concave and unimodal functions – theory of constrained optimization</td>
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<tr>
<td></td>
<td>Lagrangean method</td>
<td>1.0</td>
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<td></td>
<td>Kuhn-Tucker conditions</td>
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<tr>
<td>VI</td>
<td>Nontraditional optimization – computational complexity-Introduction to metaheuristics – areas of application</td>
<td>1.0</td>
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<tr>
<td></td>
<td>Genetic algorithm (GA) – terminologies – steps and examples</td>
<td>1.0</td>
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<td></td>
<td>Tabu search (TS) – steps and examples</td>
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<tr>
<td></td>
<td>Simulated annealing (SA) – steps and examples</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ant colony optimization (ACO) – steps and examples - Particle Swarm Optimization (PSO)-Steps and examples</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>
Question Paper Pattern

Maximum marks: 100                Time: 3 hrs

The question paper should consist of three parts

**Part A**
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3x10 marks = 30 marks)

**Part B**
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3x10 marks = 30 marks)

**Part C**
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4x10 marks = 40 marks)

Note: Each question can have a maximum of four sub questions, if needed.
Course code | Course Name                  | L-T-P-Credits | Year of Introduction |
------------|------------------------------|---------------|----------------------|
ME482       | Energy Conservation and Management | 3-0-0-3       | 2016                 |

Prerequisite: Nil

Course Objectives:
1. To enable analysis of the energy data of industries, energy accounting and balancing
2. To know energy audit and methodologies for energy savings
3. To understand utilization of the available resources in optimal ways

Syllabus:

Expected Outcomes:
The students will be able to
i. carry out energy accounting and balancing
ii. suggest methodologies for energy savings

Text books:

References:

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam. Marks</th>
</tr>
</thead>
</table>
**Components of EB billing** – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

### FIRST INTERNAL EXAMINATION

| IV  | Energy efficiency in Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets |

### SECOND INTERNAL EXAMINATION

| V   | Energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering |
| V1  | Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing – ESCO concepts |

### END SEMESTER EXAMINATION

**Question Paper Pattern**

**Maximum marks: 100**  
**Time: 3 hrs**

The question paper should consist of three parts

**Part A**
There should be 2 questions each from module I and II  
Each question carries 10 marks  
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**Part B**
There should be 2 questions each from module III and IV  
Each question carries 10 marks  
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
There should be 3 questions each from module V and VI  
Each question carries 10 marks  
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.
Course code | Course Name | L-T-P-Credits | Year of Introduction
---|---|---|---
ME484 | Finite Element Analysis | 3-0-0-3 | 2016

**Prerequisite:** Nil

**Course Objectives:**
1. To introduce the concepts of Mathematical Modeling of Engineering Problems.
2. To appreciate the use of FEA to a range of Engineering Problems.

**Syllabus:**
Historical Background, Mathematical Modeling of field problems in Engineering, Governing Equations, Basic concepts of the Finite Element Method, Solution of problems from solid mechanics and heat transfer, Fourth Order Beam Equation, Second Order 2D Equations involving Scalar Variable Functions, Equations of elasticity, Natural co-ordinate systems

**Expected Outcomes:**
- The students will be able to understand different mathematical techniques used in FEM analysis and use them in Structural and thermal problems

**Text books:**

**Reference books:**

**COURSE PLAN**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Basic concepts of the Finite Element Method. One Dimensional</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>Module</td>
<td>Exam</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>--------</td>
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<td>-------------</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>FIRST INTERNAL EXAMINATION</td>
<td>Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation – Transverse deflections and Natural frequencies of beams.</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>END SEMESTER EXAMINATION</td>
<td>Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.</td>
<td></td>
</tr>
<tr>
<td>VI1</td>
<td>END SEMESTER EXAMINATION</td>
<td>Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.</td>
<td></td>
</tr>
</tbody>
</table>

**Question Paper Pattern**

**Maximum marks: 100**

**Time: 3 hrs**

The question paper should consist of three parts:

**Part A**
There should be 2 questions each from module I and II
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Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.
Course Objectives

- To create a knowledge about human psychology
- To learn about theories of motivation and group behavior.
- To understand the socio-cultural aspects in organizations

Syllabus


Expected outcome.
The students will be able to
1. know the importance of psychology
2. have insight into individual and group behavior
3. deal with people in better way
4. motivate groups and build teams.

Text Book:

References:

---

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP469</td>
<td>Industrial Psychology and Organisational Behaviour</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Human mind- cognition- character- thinking- attention- memory- emotion- traits- attitude- personality</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Organizational behaviour- definition –development- fundamental concept- nature of people nature of organization – an organizational behaviour system- models- autocratic model- hybrid model-</td>
<td>6</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**
IV Understanding a social-system social culture-managing communication-downward, upward and other forms of communication

SECOND INTERNAL EXAMINATION

V Motivation- motivation driver- human needs- behaviour modification-goal setting- expectancy model- comparison models- interpreting motivational models- leadership- path-goal model- style -- contingency approach

VI Special topics in industrial psychology- managing group in organization- group and inter group dynamics- managing change and organizational development- nature planned change- resistance characteristic of OD-OD process

END SEMESTER EXAM

Question Paper Pattern

Maximum marks: 100 Time: 3 hrs

The question paper should consist of three parts

Part A
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions
Course Code: MP482  
Course Name: PRODUCT DEVELOPMENT AND DESIGN  
L-T-P-Credits: 3-0-0-3  
Year of Introduction: 2016

**Prerequisite:** Nil

**Course Objective**
- To create confidence in developing new products.
- To acquaint with methods and tools for product design and development.
- To equip with practical knowledge in conceptualization, design and development of new product.

**Syllabus**
Introduction to product design, the need of a product, the product life cycle, the product design process. The application of Value Engineering principles in product design. Application of various tools such as CAD, CAE and DFM. The Ergonomics aspects in context of the product design. The fundamental concept of rapid prototyping techniques.

**Expected Outcome**
The students will be able to
- i. create new products suiting the requirements of society.
- ii. enhance value addition in products
- iii. coordinate multiple factors like market, design, ergonomics manufacturing in creating a new product.

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. exam marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Design for Manufacturing and Assembly; Methods of designing for Manufacturing and Assembly. Designs for Maintainability. Designs for Environment. Product costing. Ethics in product design, legal factors and social issues.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Value Engineering / Value Analysis: Definition. Methodology. Case studies. Economic analysis: Qualitative &amp; Quantitative.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Ergonomics in product design. Aesthetics in product design. Concepts of size and texture, colour. Psychological and Physiological considerations. Creativity Techniques: Creative thinking, conceptualization, brain storming, primary design, drawing, simulation, detail design.</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

### Question Paper Pattern

Maximum marks: 100  
Time: 3 hrs

The question paper should consist of three parts

**Part A**
There should be 2 questions each from module I and II  
Each question carries 10 marks  
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
There should be 2 questions each from module III and IV  
Each question carries 10 marks  
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
There should be 3 questions each from module V and VI  
Each question carries 10 marks  
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note:** In all parts, each question can have a maximum of four sub questions
Course code | Course Name | L-T-P – Credits | Year of Introduction
--- | --- | --- | ---
MP484 | Project management | 3-0-0-3 | 2016

**Prerequisite: Nil**

**Course Objectives**
- To familiarize the major aspects of project management consisting of: Project Planning, Project Analysis, Project Selection, Project Implementation and Project Review

**Syllabus**
Planning, capital budgeting, generation of project ideas, Project analysis, Market and demand analysis, Manufacturing process and technology, Project charts, financial analysis, breakeven point, cash flow statement, time value of money, appraisal criteria, Project organisation, network techniques, PERT Model, CPM Model, Network costs

**Expected outcome.**
The students will be able to
- i. Understand Project planning
- ii. Analyse market and demand
- iii. Familiarise basic concepts of project costing and cash flows
- iv. Apply network analysis models of PERT and CPM under different situations

**Text Book:**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Analysis – Market and demand analysis – Situational analysis and specification of objectives – Collection of secondary information</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>
Conduct of market survey – Characterization of Market – demand Forecasting – Market planning – Technical analysis- Material inputs and utilities

**FIRST INTERNAL EXAMINATION**

|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**SECOND INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>V</th>
<th>Cost of capital – Cost of debt capital – cost of preference capital – Rate of return – Cost of external equity and retained earnings - Determination of weights – Appraisal criteria – Net present value – Cost benefit ratio-Internal rate of return- Urgency – payback period</th>
</tr>
</thead>
</table>

**END SEMESTER EXAM**

**Question Paper Pattern**

Maximum marks: 100 Time: 3 hrs

The question paper should consist of three parts

**Part A**
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note:** In all parts, each question can have a maximum of four sub questions
Course code | Course Name | L-T-P - Credits | Year of Introduction
--- | --- | --- | ---
MR482 | Mechatronics | 3-0-0-3 | 2016

Prerequisite : NIL

Course Objectives
- To provide basic knowledge on principles and design of Mechatronics systems.

Syllabus

Expected outcome.
- The student will acquire basic knowledge on design, and application of Mechatronics systems

Text Book:

References:
1. R. C. Dorf, R. H. Bishop, *Modern Control Systems*, Addison Wesley
2. Krishna Kant, *Computer Based Industrial Control*, Prentice Hall of Indian Private Limited

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to Mechatronics – scope - Mechatronics and Engineering Design. Sensors and transducers – classification-thermal- electrical- optical- acoustic- pneumatic- magnetic- and piezo electric sensors- Smart sensors.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Open loop and closed loop control systems - continuous and discrete processes - servo mechanism – principles - components - error detectors - potentiometers- types.</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAMINATION
| IV | Closed loop controllers - proportional- derivative and integral controls - PID controller – digital controllers - controller tuning - adaptive control of machine tools. programmable logic controllers- architecture. | 7 | 15% |

**SECOND INTERNAL EXAMINATION**

| VI | Stages in designing mechatronic systems - traditional and mechatronic design - possible design solutions - case studies of mechatronic systems - pick and place robot - automatic car park system – engine management system. | 7 | 20% |

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN**

Maximum Marks : 100  
Exam Duration:3 hours

**PART A: FIVE MARK QUESTIONS**  
8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules  
(8 x 5= 40 marks)

**PART B: 10 MARK QUESTIONS**  
5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions  
( 3 x10 = 30 marks)

**PART C: 15 MARK QUESTIONS**  
4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions  
( 2 x15 = 30 marks)
Course Code | Course name | L-T-P- C | Year of Introduction  
--- | --- | --- | ---
MT482 | INDUSTRIAL SAFETY | 3-0-0-3 | 2016

Prerequisite: Nil

Course Objective
- To understand the impact of safe industrial operations, its benefits and safety legalization.

Syllabus

Expected Outcome.
The students will
i. gain a general concept of safety,
ii. become aware of safety responsibilities of various agencies,
iii. know the occupational health hazards and human factors contributing to industrial accidents,
iv. learn the concepts of safety management,
v. understand the need for timely maintenance of equipments, the need and measures for industrial safety control
vi. become familiar with the general legal rules for an industrial safety practitioner.

TEXT BOOKS/REFERENCES
6. The Factories Act with amendments 1987, Govt. of India Publications DGFASLI, Mumbai.

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Introduction to industrial safety</td>
<td>5</td>
<td>15%</td>
</tr>
</tbody>
</table>
| II | **Safety and Health Management:**  
Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety. Ergonomics - Introduction, Definition, Objectives, Advantages. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders, Importance of Industrial safety, role of safety department, Safety committee and Function. | 7 | 15% |
| IV | **Safety Assessment and Control**  
| V | **Industrial Safety and Control**  
Control of Physical Hazards: (Purpose of lighting. Advantages of good illumination. Lighting and safety, Lighting and the work. Control of Chemical Hazards Hazardous properties of chemicals and appreciation of information provided in Material safety data sheets. Classification of dangerous materials with pictorial symbols, common hazard and common precautions for each class Control of Electrical Hazards Dangers from electricity. Safe limits of amperages, Voltages Safe distance from lines. Capacity and protection of conductors, Joints and connections, Means of cutting of power overload and short circuit protection. Statutory provisions regarding fire safety. Factors contributing towards fire. Chemistry of fire. Classification of fires. Common causes of industrial fires. | 9 | 20% |
| VI | **Safety Legalisation**  
Legal Provisions regarding safety, Accident prevention & Compensation to affected employees as under Factories Act-1948, Factories Act(Amendment)1987, Maharashtra Factories Rule- | 5 | 20% |

END SEMESTER EXAMINATION

QUESTION PAPER PATTERN

Maximum Marks : 100
Examination Duration: 3 hrs.

PART A: 8 questions from Module 1&2 (4+4) – 6 questions to be answered. 6 X 5 = 30 marks
PART B: 8 questions from Module 3&4 (4+4) – 6 questions to be answered. 6 X 5 = 30 marks
PART C: 6 questions from Module 5&6 (3+3) – 4 questions to be answered. 4 X 10 = 40 marks
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name:</th>
<th>L-T-P- Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>SB482</td>
<td>DREDGERS AND HARBOUR CRAFTS</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisites:** -Nil-

**Course Objectives:**

- To impart various aspects of dredging
- To introduce various aspects of operation of dredgers and harbor crafts

**Syllabus:**

Types of Dredging Equipment, Types of Dredgers, Trailing suction hopper dredger, The cutter suction dredgers, Plain suction dredgers, Barge unloading dredgers, Bucket dredgers, Grab or Clamshell dredgers, Backhoe or dipper dredgers, Navigation Aids Vessels, Tugs and Towboats, Firefighting tugs, Barges, pilot boats, Salvage/buoy vessels, Construction Support Vessels, Fireboats, Patrol and Rescue Vessels, Pollution Response Vessels, Floating docks

**Expected Outcome:**

The students will be able to:

1. Understand different types of dredging and dredging equipment
2. Analyse the design aspects of 7 types of dredgers
3. Know the operational aspects of dredgers
4. Understand the design and operational philosophy of harbor craft, including floating dock

**Text Books:** Ship Design and Construction, Volume II, SNAME 2004

**Reference Books:**

- Lloyd Register of Shipping, Rules and Regulations for the Classification of Ships - July 2015
- D Esima, Dredging in Coastal Waters, Taylor & Francis Group, 2005
- Rolt Hammond, Modern Dredging Practice, Muller, London, 1969
- Denis Yell, ICE Design and Practice guide – Dredging, ASCE, 1995

**Course Plan:**

<table>
<thead>
<tr>
<th>Module</th>
<th>Content</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction, Types of Dredging Equipment, Types of Dredgers</td>
<td>2</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Harbour/ Port support vessels</td>
<td>2</td>
<td></td>
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<tr>
<td></td>
<td>Small Workboats</td>
<td>2</td>
<td></td>
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<tr>
<td>II</td>
<td>Dredging process</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Introduction to dredging equipment, Types, Mechanical Dredgers, Hydraulic dredgers</td>
<td>2</td>
<td>15%</td>
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<tr>
<td></td>
<td>Trailing suction hopper dredger – General description, design, technical construction, strength and stability, Dredging process</td>
<td>3</td>
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<tr>
<td>Module</td>
<td>Subtopics</td>
<td>Marks</td>
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<tr>
<td>III</td>
<td>The cutter suction dredgers - General description, design, Dredging equipment, Drives, Spud systems, technical construction, Dredging process</td>
<td>3</td>
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<tr>
<td></td>
<td>Plain suction dredgers – Types, working method, design, layout, Technical construction, Dredging process</td>
<td>3</td>
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<tr>
<td></td>
<td>Barge unloading dredgers - General description, design, , layout, Technical construction, Dredging process</td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td>Bucket dredgers - General description, Area of application, method of working, design, Technical construction, Dredging process</td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td>Grab or Clamshell dredgers – Working method, Areas of application, Design aspects, layout, production capacity</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Backhoe or dipper dredgers - General considerations, Working method, Area of application, Main Layout, Production capacity</td>
<td>3</td>
<td></td>
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</tbody>
</table>

**SECOND INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>Module</th>
<th>Subtopics</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Major features of following harbor crafts:- Navigation Aids Vessels</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Tugsand Towboats, Firefighting tugs</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Barges, pilot boats</td>
<td>2</td>
</tr>
<tr>
<td>VI</td>
<td>Major features of following harbor crafts:- Salvage/buoy vessels</td>
<td>1</td>
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<tr>
<td></td>
<td>Construction Support Vessels</td>
<td>2</td>
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<tr>
<td></td>
<td>Fireboats, Patrol and Rescue Vessels</td>
<td>2</td>
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<tr>
<td></td>
<td>Pollution Response Vessels, Floating docks</td>
<td>1</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAMINATION**

**QUESTION PAPER PATTERN:**

- Maximum Marks: 100
- Exam Duration: 3 Hours

**PART A**

- Answer all 8 questions of 3 marks each.
- 1 question each from modules I to IV and 2 questions each from modules V & VI.

**PART B**

- Answer any 2 complete questions out of 3 for each module.
- Each question from module I to IV carries 6 marks.
- Each question from module V & VI carries 7 marks.
- Each complete question can have maximum of 4 subsections.